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Food and Agriculture Organization of the United Nations

An international journal of forestry and forest industries

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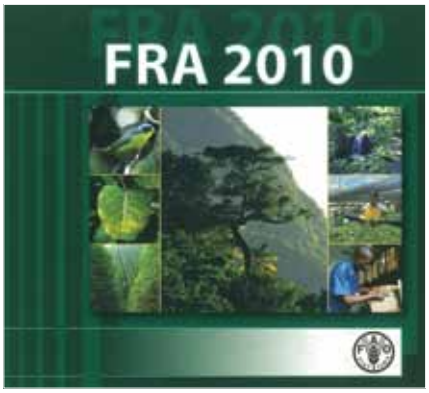

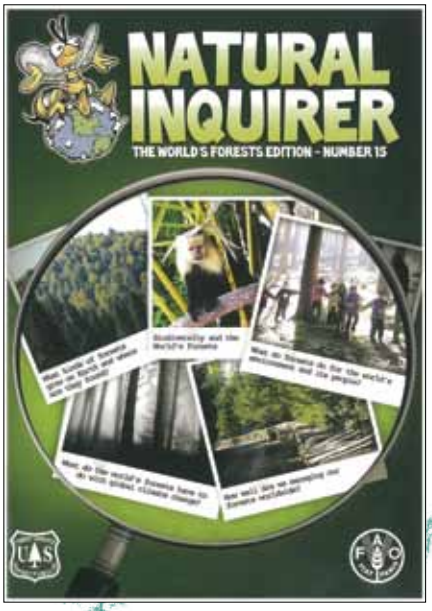

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Cover: Kindergarten children do a stretching exercise during a visit to a forest in the Republic of Korea. FAO/FO-7393/Beomtae Kim

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The power of forests

This edition of *Unasylva* comes in the wake of the United Nations Conference on Sustainable Development, Rio+20, which, among other things, produced a document called *The Future We Want*. In it, world leaders renewed their commitment to sustainable development and stated that "the wide range of products and services that forests provide creates opportunities to address many of the most pressing sustainable development challenges".

Foresters should be pleased with these words because they indicate that forests are starting to get the recognition they deserve. In this edition of *Unasylva* we look at the power of forests to bring about sustainable development. In their overview article, Rao Matta and Laura Schweitzer Meins set out the many contributions that forests can make, such as the sustainable provision of food, energy, wood and ecosystem services. They call for a repositioning – towards the centre – of forests in sustainable development initiatives and say that strong global leadership is needed "to instil broad understanding about the socio-economic benefits of investing in forests".

Don Koo Lee writes about the extraordinary reforestation efforts of the Republic of Korea since the 1960s and sets out the role of forests in achieving his country's vision of a low-carbon, green-growth society. The experiences of the Republic of Korea show the power of forests to restore ecological integrity and support sustainable economic development. The government is now reaching out regionally in the hope of assisting other countries in their own endeavours.

Maharaj Muthoo describes forest certification as a soft policy instrument to encourage ethical trade and commerce and improve market access for forest products, including both wood and non-wood products. He says that forest certification can be an agent of sustainability, equity and justice in the forest sector and suggests that innovative people–public–private partnerships are needed to best exploit its potential.

If the forest industry is to be an effective contributor to sustainable development it is essential that its employees enjoy safe working conditions. Claudia Peirano describes a process of ongoing training and social dialogue in Argentina that has halved forest-sector accidents.

Zoraida Calle and her co-authors make a case for a shift from input-intensive cattle-grazing on degraded pastures in Latin America to environmentally friendly intensive silvopastoral systems, claiming that the incorporation of trees in cattle-ranching systems will reduce soil degradation, sequester carbon and help protect water resources. It will also create jobs – perhaps five times as many as conventional cattle-ranching – and produce high-quality food and other products. Pedro Brancalion and his co-authors show that the restoration of degraded forest lands can increase incomes for ranchers and farmers through the production of timber and the sale of ecosystem services, among other things. Cattle-ranching is so widespread in Latin America that a move towards silvopastoral systems and forest restoration could have a huge positive effect on the environment, the productivity of the land and employment.

The late Alf Leslie, an innovative thinker, once predicted that the value of ecosystem services would be worth US$2.6 trillion per year in 2040, more than ten times the value of all other forest products combined (Leslie, 2005). This is only one person's (informed) guess, but monetizing even a relatively small fraction of such value would have huge implications for forests and their owners, managers and dependents. Interest has been growing in REDD+, a proposed policy to incentivize developing countries, through financial payments, to deliver forest-based ecosystem services related to greenhouse gas abatement. While negotiations have tended to focus on reducing deforestation in tropical rainforests, Margaret Skutsch and Mike McCall make a case for community forest management in REDD+ and suggest that it may be more effective in addressing emissions from degradation than from deforestation and that it may be particularly efficient in dry tropical forests. Abidah Setyowati says that negotiations on REDD+ need to better incorporate a gender perspective or risk further disadvantaging women.

Rounding out this edition of *Unasylva* is an article by Alberto Del Lungo on a regional FAO project to promote the use of urban wastewater for irrigating tree plantations in four North African countries, and an article by Robert Simpson and co-authors describing the outcomes and second phase of an initiative to strengthen forest law enforcement, governance and the legal trade of timber.

The articles in this edition of *Unasylva* suggest that awareness of the role of forests, and a willingness to pay for that role, will grow in coming decades; forests are too culturally, ecologically, economically and socially important to be neglected for much longer. Their move into the mainstream of development policy will do the world a power of good.

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FAO/G. NAPOLITANO

Repositioning forests in development

J.R. Matta and L. Schweitzer Meins

Forests are critical for a sustainable future and need to be "mainstreamed" into economic policy and decision-making.

Jagannadha Rao Matta is Forestry Officer, FAO, Rome. **Laura Schweitzer Meins** is a forestry expert; her work for this article was supported by the Global Mechanism of the United Nations Convention to Combat Desertification.

For millennia, people have benefited and prospered from our planet's abundant resources. Now, there are seven billion of us (United Nations Population Fund, 2011), but while our numbers are still increasing, resources are not. The concept of sustainable development responds to knowledge of the limits to resources. For example, the Brundtland Commission's report *Our Common Future* (UNWCED, 1987), which helped popularize the concept of sustainable development, implied that the nature and magnitude of our economy should be managed within the regenerative and assimilative capacities of our biosphere (Daly, 2002).

The world economy has quadrupled in the last quarter-century, to the benefit of hundreds of millions of people. Yet there is significant evidence that this development has not been sustainable. According to the Millennium Ecosystem Assessment (2005), over 60 percent of the world's major ecosystem goods and services are degraded or being used unsustainably, and rapid urbanization has exacerbated problems of pollution, waste generation and congestion (UNCSD, 2010). Despite repeated warnings about the environmental, social and economic risks associated with human-induced climate change, the rate of greenhouse gas emissions continues to grow (*The Guardian*, 2011).

Above: Youngsters fish in a creek in the Yoko Forest, Democratic Republic of the Congo. Hunting and fishing on forested land supplies more than one-fifth of protein requirements in around 60 developing countries

While economic progress has been dramatic at a global scale, those benefits have not been shared equitably between or within countries (UNCSD, 2010). Thirteen percent of people in the developing world still lack access to adequate clean water (World Health Organization, 2011) and twenty-five percent have little or no access to modern energy services (International Energy Agency, 2009). In addition, rapid but non-inclusive economic growth has become a major driver of political and social unrest in many parts of the world (Sreedharan and Matta, 2010). As the human population continues to expand and per capita consumption rises, the already stressed biosphere will become increasingly strained; for example, the area of arable land per capita has declined since the 1960s as a result of overly intensive use as well as degradation and urbanization (IFPRI, 2011). With such an outlook, the need to re-examine and refocus our efforts to ensure a sustainable future is evident.

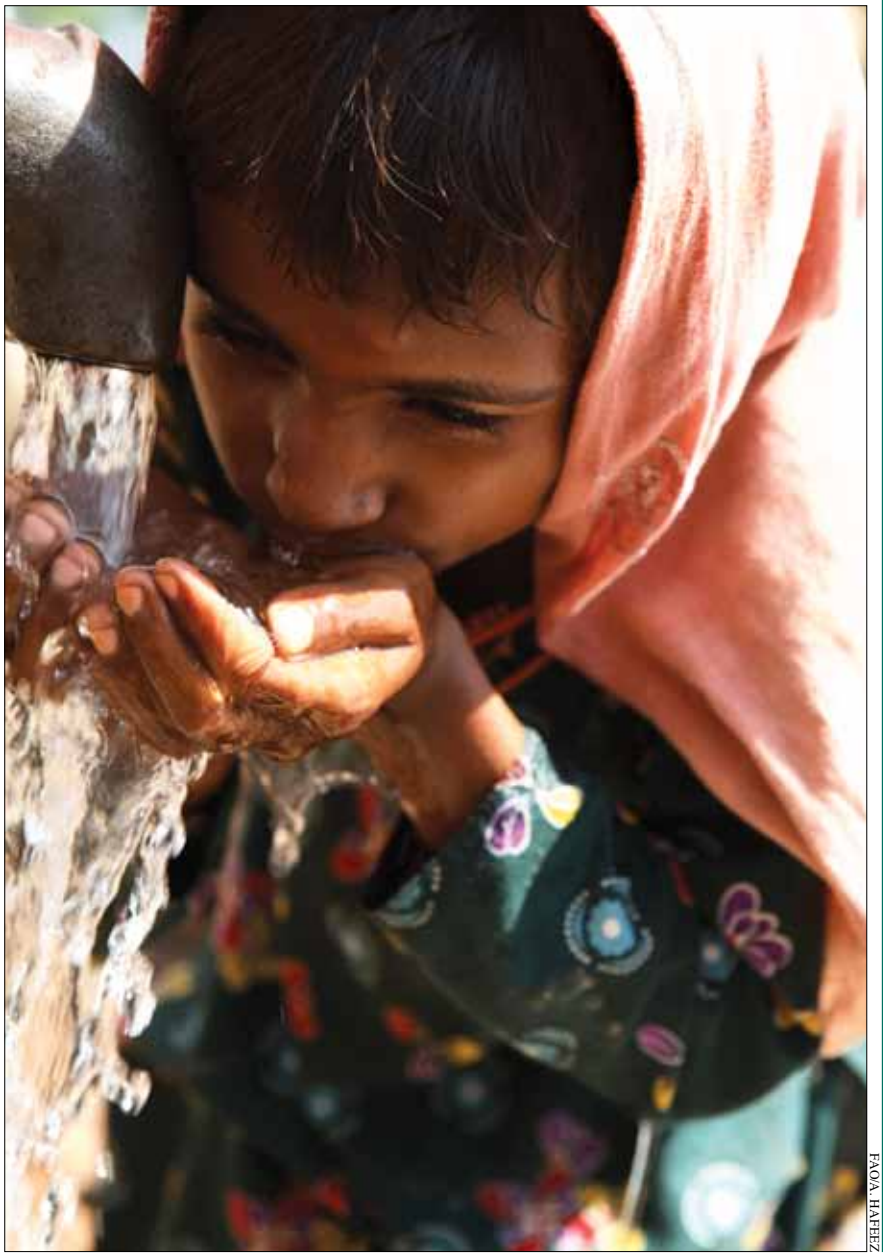
THE CONTRIBUTION OF FORESTS TO SUSTAINABLE DEVELOPMENT

In many countries, development is needed to increase employment and raise the standard of living (Dasgupta, 2011). To be sustainable, however, development activities must balance economic, social and ecological factors. Forests are a unique resource for accomplishing this balance because of their capacity to respond to multiple economic, social and ecological needs and challenges, and because of their renewability.

Forests provide food and energy

Close to 350 million of the world's poorest people, including 60 million indigenous people, depend almost entirely on forests for their subsistence and survival (FAO, 2012a). They include the most disadvantaged and vulnerable – and often the politically weakest – people in society. For them, forests are an important source of food and medicine; for example, hunting and fishing on forested land supplies more than one-fifth of protein requirements in around 60 developing countries (Mery *et al*., 2005). Moreover, forests provide many of the raw materials used by local entrepreneurs. In Cameroon, for example, small forest enterprises based on honey, the bark of *Prunus africana*, bush mango (*Irvingia* species) and gum Arabic (based on *Acacia senegal*) have enabled many local people to earn cash income that may subsequently be used to purchase food, fuel and other critical goods (FAO, 2012b).

In addition to improving food security, forests play an important role in slowing and reversing land degradation due, in large part, to their ability to replenish and increase the retention of soil nutrients. As a result, sustainable forest management and forest restoration have come to



FAO/A. HAFEEZ

A child drinks from a communal pump, Sukkur, Pakistan. Thirteen percent of people in the developing world still lack access to adequate clean water

FAO/J. FOTSING

*Small forest enterprises based on the fruit of the bush mango (*Irvingia *species) generate employment and income for many local people in Cameroon*

be recognized as critical approaches for addressing major food security challenges such as desertification and soil degradation. Agroforestry and silvopastoral land management both capitalize on the protective functions of trees and forests to increase food production over time (Calle, Murgueitio and Chará, 2012).

Forests also play a key role in producing fuel: for more than two billion people, wood energy is critical for cooking, heating and food preservation (i.e. smoked food products) (FAO, 2010a). Moreover, charcoal and fuelwood are often primary sources of cash for poor people living in and around forests (FAO, 2006). Significant research is under way on the use of forest biomass as a sustainable, clean high-tech energy source (FAO, 2008).

Forests contribute to job creation and improved livelihoods

Forests have come to be recognized as engines of rural economic development. In southern China, for example, forest-related activities contribute as much as 40 percent of farm income (The World Bank, 2006). Globally, the formal forest sector accounts for nearly 1 percent of gross world product (the sum of the gross domestic products of all countries) and generates at least ten million formal-sector jobs (FAO, 2010a). If employment in informal, small and local forest enterprises is considered, it is likely that more than 100 million people are employed in forest-related jobs (Macqueen, 2008).

Over time and with financial and technical support and capacity development, the increased use and marketing of wood and non-wood products will create new enterprises, more employment opportunities and increasingly secure livelihoods. Tools such as certification and ecolabelling could add to the marketability of forest products (Muthoo, 2012). A positive feedback loop could thus be created as greater local income increases consumption, which in turn would stimulate production and create further employment. Forest restoration also holds the promise of substantial job and income creation (Calle, Murgueitio and Chará, 2012; Brancalion *et al*., 2012).

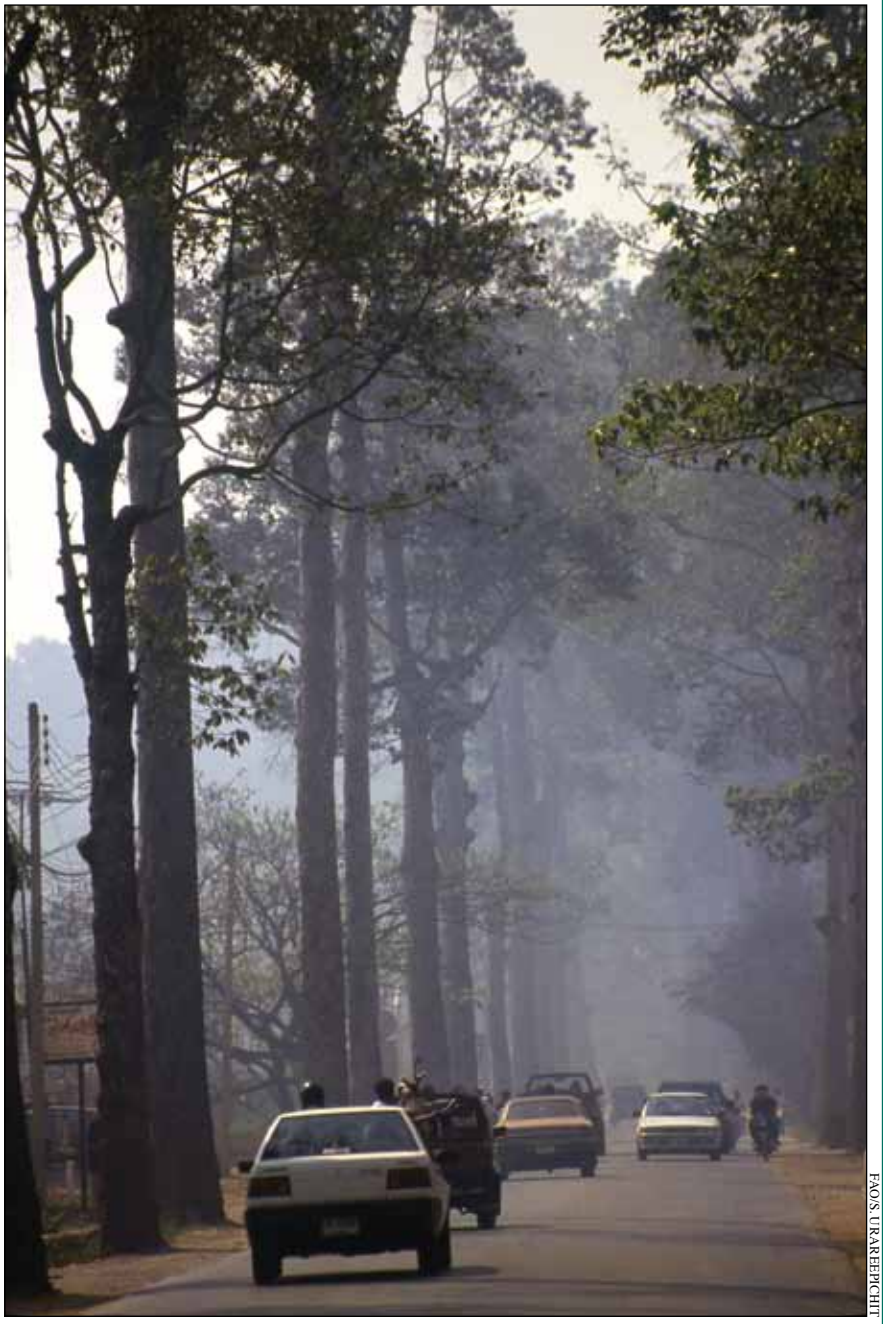
Forests provide critical ecosystem services

Forests perform a wide range of ecosystem services. They help to regulate hydrological cycles and reduce the threat and impact of floods and drought (Daily *et al*., 1997), and they are home to more than 80 percent of the world's terrestrial biodiversity (WWF, 2012). Forests also play a major role in the global carbon cycle, including by storing about 289 gigatonnes of carbon in their biomass (FAO, 2010a). Further investments in sustainable forest management and forest restoration could increase the storage of carbon in forests (Skutsch and McCall, 2012). Additionally, the better integration of forestry and farming is rapidly coming to be understood as a significant component of ensuring sustainable agriculture and food security. For example, transitioning from traditional agriculture to agroforestry has the potential to sequester up to 25 additional tonnes of carbon per hectare (ha) per year (Matta, 2009; see also Brancalion *et al*., 2012). Forests can also help put wastewater to productive use (Del Lungo, 2012).

Forests supply an array of products

Forest ecosystems provide a variety of wood and non-wood products that are intrinsically natural and recyclable and are often reusable and biodegradable. There is great potential for the increased use of such products, for example in "green" buildings and other infrastructure, as recyclable car and computer parts and in foods, medicines and cosmetics. The increased and innovative use of forest products could lead to dramatic changes in the way we lead our lives. Increased prosperity and the growing demand for more sustainable consumption and lifestyles is likely to create increased demand for sustainably produced products. Given that forest-based products can so simply and readily respond to such demand, the importance of forests to both producers and consumers is likely to be increasingly demonstrated.

Urban forestry plays an important role in making cities livable



FAO/S. URAREEPICHIT

Forests foster healthier and more livable cities

Forests are important for our cultural, aesthetic and recreational fulfillment. With more leisure time and discretionary income, interest among urban-dwellers in the recreational use of forests has increased dramatically; for example, as much as one-half of world tourism is nature-based (FAO, 2012a). Urban residents can be affected by forest loss if it leads to an increased incidence of flood or drought or a decline in urban water quality. Trees can further help urban dwellers by mitigating the "heat-island" effect – the phenomenon whereby urban areas are hotter than surrounding rural areas. Urban forestry serves an important role in regulating temperature within cities (FAO, 2002), and has also assisted in water management and the creation and expansion of urban and peri-urban green spaces and recreation areas. It has even been linked to a reduction in crime in inner-city areas (Kuo and Sullivan, 2001).

Forests mitigate and lessen the impacts of disasters

Forests can provide a means of mitigating and coping with shocks resulting from catastrophic events. For example, there is considerable evidence that coastal forests can reduce the impacts of cyclones and other disastrous events and thereby lessen damage to property and reduce the loss of life (Braatz *et al*., 2006). Such crises can lead to the creation of forestry programmes that benefit local populations in the long run. Mexico's programme of payments for hydrological services, which provides financial incentives to landowners to maintain forest cover in critical watersheds, was established primarily in response to severe drought conditions and water scarcity (Munoz *et al*., 2008). In China, devastating floods along the Yangtze River spurred the government to initiate the Sloping Land Conversion Programme, which set out to convert 14.7 million ha of croplands to forest (Bennet and Xu, 2005).

FORESTS AND A SUSTAINABLE FUTURE

While there are compelling reasons to conserve forests and encourage the integration of forests into sustainable development strategies, the risks forests face from degradation, fragmentation, conversion to other uses and unsustainable exploitation are high. For example, about 130 million ha of forest, including 40 million ha of primary forest, were lost in the period 2000–2010 (FAO, 2010a).

The 20th anniversary of the landmark 1992 United Nations Conference

on Environment and Development, also known as the Earth Summit, was marked in 2012 by the United Nations Conference on Sustainable Development, held in Rio de Janeiro, Brazil (and known as Rio+20). There, world leaders and other representatives of civil society identified seven areas in need of priority attention: jobs, energy, cities, food, water, oceans and disasters (UNCSD, 2012).

Forests play a critical role in each of these areas, but this role is often underappreciated. Up to now, forests have rarely been foremost in the minds of policy-makers, and many of their contributions to society are unknown outside the forest sector (FAO, 2010b). The final outcome document of Rio+20, *The Future We Want*, devotes just four paragraphs (in a 283-paragraph document) to forests (United Nations General Assembly, 2012).

Nevertheless, *The Future We Want* does stress the importance of integrating sustainable forest management objectives and practices into the mainstream of economic policy and decision-making. Doing so will involve creating an understanding of the benefits of mainstreaming, getting commitment from decision-makers for identified actions, and ensuring that those actions are carried out on the ground. It will require strong global and national leadership and concerted action on several fronts. Profound adjustments in policies and practices must be made unflinchingly. The articles in this issue of *Unasylva* (some of which are cited here) provide a glimpse of some of the avenues being explored to strengthen the forest sector and its role in sustainable development.

Incentives designed to encourage investment in forest-related activities and stimulate the creation of new markets will be needed, in tandem with the development of appropriate regulatory frameworks. Paying for forest ecosystem services, for example, could significantly change the market dynamics of forest enterprises and increase their financial viability. This, in turn, could lead to greater investment in forestry and ultimately to additional income and livelihood opportunities for local communities. To ensure a level playing field for forest products (Martin, 2008), policies are needed to ensure that the prices of unsustainable, or "non-green", products reflect their full environmental costs (e.g. in terms of pollution, energy use, global greenhouse gas emissions and waste disposal).

Underlying issues such as land tenure and governance must be addressed, and policies should be put in place to encourage local forest-based enterprises, cooperatives and forest governance. REDD+ mechanisms must include specific safeguards to ensure that the flow of benefits is sustainable, inclusive (particularly of women; see Setyowati, 2012) and participatory.

In some countries, regulatory and voluntary compliance policies have created disincentives for landowners to carry out sustainable forest management. The environmental and sustainability credentials of wood products – that they are renewable, recyclable, biodegradable and require less energy to produce – need greater visibility. Policy-makers and development practitioners should take a hard look at existing policies and regulatory frameworks to ensure that they foster an enabling environment that promotes forest industry, including small and medium forest enterprises, and broadens the range of forest values and benefits by developing new and innovative products and services.

Strong global leadership and concerted communication, knowledge-sharing and networking are also needed to instil broad understanding about the socio-economic benefits of investing in forests. Organizations leading such efforts may have to move beyond conducting occasional symposiums and side-events and employ modern-day digital technologies and web-based outreach methods, which have unprecedented potential for scaling up success stories. Considering the global benefits provided by forests, interventions that increase appreciation of the value of forest goods and services and the benefits of using forest products must be made at both the country and global levels.

Rio+20 has provided us with the opportunity to rethink sustainable development. Perhaps now is the time for a real and meaningful paradigm shift to embrace forests in our thinking and actions on achieving genuinely sustainable development. We can still have the forests we want. ◆

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The forest sector's contribution to a "low carbon, green growth" vision in the Republic of Korea

D.K. Lee

The country is pursuing green growth through the sustainable management and conservation of its forests and expanding its regional role.

Don Koo Lee is Minister of the Korea Forest Service, Daejeon, Republic of Korea.

The Government of the Republic of Korea has designed a strategy to create a green society through its new national vision for the coming 60 years – "low carbon, green growth". It aims to change the current approach, which involves an energy system that emits a large amount of greenhouse gases, into a low-carbon, more sustainable one. A smooth transition towards a greener economy requires specific enabling conditions, including national regulations, policies, subsidies and incentives; and international market and legal infrastructure, trade and technical assistance (UNEP, 2011).

This article describes some of the Republic of Korea's enabling activities over the past 60 years that will help move its vision forward for the next 60 years. It presents the successful reforestation of degraded forest areas in the Republic of Korea; discusses the flow of forest policies to increase forest value in the context of the government's "low carbon, green growth" vision; and identifies the role of the country's forest sector, both nationally and internationally, in green growth.

The "bleeding heart" flower, Lamprocapnos spectabilis, grows in a forest in the Republic of Korea

FAO/FO-7401/MYUNGGI JOO

FOREST LOSS AND FOREST RECOVERY

The forests of the Republic of Korea cover 6.4 million hectares (ha), or about 64 percent of the total land area. In the past, particularly during the first part of the twentieth century, forests in the country were severely degraded. Until the 1960s, forests in the Republic of Korea suffered because of wars, illegal cutting and uncontrolled shifting cultivation. The timber stock volume dropped sharply to about 10 m^3 per ha. However, after a series of successful reforestation programmes, described below, the stock had grown to 126 m^3 per ha by 2010 (see, for example, Figure 1). Table 1 shows the increase in growing stock over time. The reforestation projects carried out by the Government since 1945 have resulted in about 12 billion trees planted on 4.25 million ha of land across the nation (Korea Forest Service, 1997).

TABLE 1. Forest area and growing stock over time

Year	Area (1 000 ha)	Growing stock (1 000 m^3)	Growing stock (m^3 per ha)
1960	6 700	63 995	9.6
1970	6 611	68 772	10.4
1980	6 567	145 694	22.2
1990	6 476	248 426	38.4
2000	6 430	387 758	60.3
2010	6 369	800 025	125.6

Source: Korea Forest Service.

Fuelwood plantation project, 1945–1976

The main causes of forest loss were large-scale clearing of forests and exploitation of forest resources for food and fuel. A substantial amount of fuelwood was required for heating homes in winter. The government initiated national fuelwood plantations in 1945, but the plans ended when the Korean War broke out in 1950. According to an inspection conducted in 1972, 56 percent (436 000 ha) of total plantations (780 000 ha) had survived (Lee, Lee and Kim, 1999).

During the 1960s and 1970s, in response to critical demand for wood for fuel energy in local communities, the government implemented a massive plantation plan using fast-growing trees. Species such as pitch pine (*Pinus rigida*), black locust (*Robinia pseudo-acacia*), alder (*Alnus* species) and sawtooth oak (*Quercus acutissima*) were planted, mostly from 1962 to 1972. Economically valuable species of fruit trees such as sweet chestnut (*Castanea crenata* var. *dulcis*) and timber-producing species such as Japanese larch (*Larix kaempferi*), Korean pine (*Pinus koraiensis*) and Japanese cypress (*Chamaecyparis obtusa*) were also planted. Of the total forested area, 30 percent consisted of human-made plantations (Lee, 2000). This planting not only contributed to the fuelwood supply and expansion of the country's forest area, it also provided various ecological (e.g. biodiversity conservation and erosion control) and economic benefits.

1
Degraded forest in Pohang, Gyeongbuk Province, in the 1960s (top). In 1974, this area benefited from an erosion control project. The same area in the 1990s (bottom) shows the result of successful rehabilitation and restoration

Source: Korea Forest Service.

National Forest Plans: evolution over time

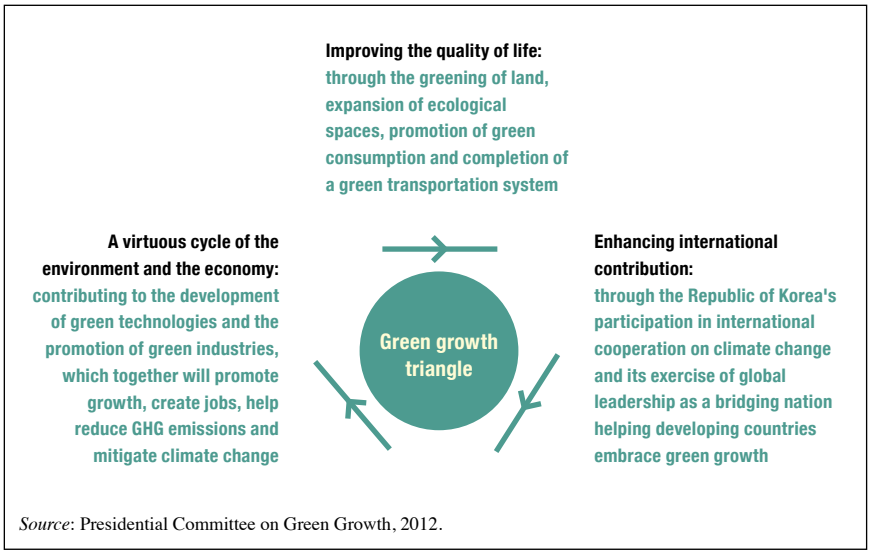
The government has been implementing National Forest Plans since 1973, when the First Ten-year National Forest Plan for rehabilitation and restoration was established. Under this plan, an additional 207 000 ha of plantations was created. Additionally, from 1976 to 1977, about 127 000 ha of plantations (20 percent of the total plantation areas) was established through an International Bank for Reconstruction and Development (IBRD) loan of US$4.4 million (Korea Rural Economic Institute, 1978). By 1977, the total area of plantations in the country had reached 643 000 ha (Table 2).

TABLE 2. Area of fuelwood plantation

Year	Area	
	Planned	Established
1959–1966	800 000	–
1967–1972	514 000	436 000
1973–1977	207 000	207 000
Total	1 521 000	643 000

Source: Song, 1982.

2
"Green growth triangle" foreseen in the "low carbon, green growth" strategy


Improving the quality of life:
through the greening of land, expansion of ecological spaces, promotion of green consumption and completion of a green transportation system
A virtuous cycle of the environment and the economy:
contributing to the development of green technologies and the promotion of green industries, which together will promote growth, create jobs, help reduce GHG emissions and mitigate climate change
Green growth triangle
Enhancing international contribution:
through the Republic of Korea's participation in international cooperation on climate change and its exercise of global leadership as a bridging nation helping developing countries embrace green growth

Source: Presidential Committee on Green Growth, 2012.

National Forest Plans have been adapted, over time, to reflect changing circumstances. From 1973 to 1987, the government concentrated on the reforestation of degraded forests through the First and Second Ten-year National Forest Plans. From 1988 to 1997, through the Third National Forest Plan, the government focused on the efficient use of forest resources to increase the economic value of forests and to improve public benefits. The Fourth Ten-year National Forest Plan, which was in effect from 1998 to 2007, established a foundation for sustainable forest management by developing a domestic framework and criteria and indicators, as well as by promoting the participation of civil-society organizations in forest management.

A new type of National Forest Plan: maximizing forest functions for green growth

Based on the foundations and frameworks established under the Fourth Plan, the Fifth National Forest Plan (2008–2017) is designed to expand the implementation of sustainable forest management. In particular, the Plan highlights the importance of forest functions, including carbon sinks, in responding to climate change. In implementing the plan, the Korea Forest Service continues to establish a foundation for the sustainable welfare of society by developing environmental and social resources, and to pursue forest-related industries as a "blue ocean strategy".[1]

The overall vision of the Fifth Plan is "to realize a green nation with sustainable welfare and growth" by sustainably managing forests as key resources for strengthening the nation's economic development, land conservation and quality of life.

FORESTS AND "LOW CARBON, GREEN GROWTH"

National strategy

In 2008, in recognition of the need to ensure sustainable development, the government announced a "low carbon, green growth" strategy as a new vision to guide the nation's long-term development. This strategy contains policy goals to tackle climate change and energy issues, to create new growth engines through investment in environmental sectors, including forests, and to develop an ecological infrastructure (Figure 2). The following year, the Presidential Committee on Green Growth was established, and the National Strategy for Green Growth was released. As a medium-term plan to implement this Strategy, the Five-year Plan for Green Growth was announced and is being implemented by various ministries and offices.

In addition, the Framework Act on Low Carbon, Green Growth, the first law of its kind in the world, was enacted, which laid the foundation for the implementation of relevant policies. This Act enabled comprehensive and systematic approaches towards green growth.

The National Strategy for Green Growth envisages three main objectives and ten policy directions, based on a consensus

Saemaul Undong: reinforcing reforestation

The successful reforestation of degraded forest is attributable not only to the massive implementation of forest plans, but also to the initiation of a new community movement called "Saemaul Undong". Launched in 1970 by the president, Saemaul Undong was an effort to modernize the rural economy of the Republic of Korea. Through this movement, the government was able to support human resources by promoting education and conducting training programmes in various parts of the country (Lee and Lee, 2005) to increase the number of forest managers and specialists while boosting reforestation and forest management efforts. Local communities were consulted upon implementation of forest policies, and the need for fuelwood was addressed in rural areas through the implementation of fuelwood plantation projects. Along with these projects, the government provided financial support to local communities through *forest kyes* (mutual aid associations).

[1] As used here, a "blue ocean" is a market that is not yet in existence and is therefore not affected by competition. A blue ocean strategy, as set out by Kim and Mauborgne (2005), describes the growth that an entity can generate by creating demand in a new marketplace.

Source: Korea Forest Service.

3
Wood pellets (left), a greenhouse heated by a wood-pellet boiler (centre), and the wood-pellet processing plant (right), the Republic of Korea

among societal, business, academic and government stakeholders. The three objectives are the mitigation of climate change and the strengthening of the country's energy independence; the creation of new growth engines and improvement of the quality of people's lives; and the enhancement of the Republic of Korea's international contribution.

The Five-year Plan for Green Growth of the Korea Forest Service

The government believes that forests are key resources for green growth. Forests in the Republic of Korea sequestered 41 million tonnes of CO_2 in 2007, which was equivalent to 66 percent of total carbon emissions in the country (Lee, 2010). To maximize forest value as a key resource, the Korea Forest Service has been working on pursuing green growth through such methods as bioenergy technology development, the conservation of forest resources, offering recreation forests and expanding urban forests, among others. Aside from the development of eco-friendly products, the Korea Forest Service is striving to improve its market competitiveness and to promote the production of high-value forest products like mushrooms, chestnuts, and medicinal plants.

The Korea Forest Service focuses on promoting the systematic implementation of forest conservation and management for the purpose of achieving well-balanced land development and conservation. It also plays a central role in efforts to prevent and mitigate the effects of natural disasters, including improving ecosystem health and vitality and contributing to public safety and environmental conservation. The Korea Forest Service highlights the recreational and cultural functions of forests to improve the quality of life and the living environment in both urban areas and mountain villages.

In accordance with the Five-year Plan for Green Growth, the Korea Forest Service is pursuing the following forest policies: 1) reinforcement of a carbon cycle economy, with an emphasis on renewable forest resources; 2) conserving and managing forest resources; 3) improving the quality of a "green life"; and 4) sharing experiences and contributing to international dialogue. The next sections discuss these in more detail.

Reinforcing an economy based on the carbon cycle, using renewable forest resources

Since timber and forest biomass, such as wood pellets, are renewable natural resources that function as alternative fuel and carbon sinks, they are considered key resources for addressing climate change (Figure 3). In addition to supporting wood-pellet processing plants, wood-pellet boilers will be supplied to a large number of rural households. Biocirculation forests will be developed in areas in which *Pinus rigida* is concentrated. In some 24 villages across the country, timber produced within villages will be used to construct low-carbon wooden houses and facilities, creating sustainable villages. Timber supply systems have been constructed to enhance the value added of domestic timber resources, as well as to create new timber demand by developing eco-friendly wooden goods and to foster the forest biomass industry.

Conserving and managing forest resources as green assets

Among the protected areas designated to conserve biodiversity and enhance the functions of forest resources are the Baekdu-daegan Mountains, which are considered the backbone of the Korean Peninsula.

KOREA FOREST SERVICE

Engraved stone in the Baekdu-daegan Mountains, the Republic of Korea

FAO/FO-7394/BEOMTAE KIM

Lilies grow on the forest floor in spring, Republic of Korea

The Baekdu-daegan Mountains are a major range that stretches about 1 400 km from Mount Baekdu in the Democratic People's Republic of Korea to Mount Jiri in the Republic of Korea. The range provides habitat for a great variety of flora and fauna and so is at the core of biodiversity conservation. The Act on the Protection of the Baekdu-daegan Mountains was legislated by the government in 2003 to preserve them. Based on the Act, land-development restrictions are placed on protected areas. About 263 000 ha (4 percent of the total forest cover) of protected areas in the country have been designated and classified into core and buffer zones of 170 000 ha and 93 000 ha, respectively (Korea Forest Research Institute, 2003).

As climate change has an impact on various elements that make up the forest ecosystem, capacity-building for adaptation to climate change is emphasized. The Korea Forest Research Institute has designated long-term ecological research sites to monitor the distribution of forest vegetation, changes in biodiversity and physiological reactions. In particular, monitoring sub-alpine species will be reinforced, as these populations are expected to decrease. In addition, adaptive systems for disaster mitigation and response, as well as vulnerability assessment, are being developed as part of preventive measures against large-scale forest fires, landslides and forest pests. A programme of thinning and pruning pine trees contributes to maintaining healthy forests and enhancing their resilience, as well as preventing damage from forest fires.

Improving the quality of green life using forest resources

There is an increasing need for eco-friendly products and lifestyles and renewable energy. As well, the Republic of Korea is facing the challenge of an aging population. Forest resources are starting to be recognized as health assets for the elderly and the young, for healing, and as recreational spaces (Figure 4). According to a survey undertaken by the Korea Forest

From cradle to grave ... life with forests

Prenatal	Early childhood	Adolescent	Adult and middle age	Third age	Death
Prenatal care	Kindergarten	Camping in forests	Recreational forests	Nursing homes in forests	Tree burial forests
15 places by 2012	60 places by 2012	200 places by 2012	10 places for leisure 157 places for recreation	2 pilot projects by 2012	36 burial grounds

Source: Korea Forest Service.

4
A new paradigm for using forests to improve the quality of life

ASEAN

5
The Agreement between the Governments of the Member States of ASEAN and the Republic of Korea on Forest Cooperation was signed by foreign ministers during the 19th ASEAN Summit (18 November 2011, Bali, Indonesia)

Service, forests are used by about 20 million mountain hikers each year. Another survey showed that 77 percent of the people polled who were undergoing long-term healthcare prefer to stay in healing places, such as forests, during their continuing care. The Korea Forest Service is therefore establishing green welfare infrastructure, including recreational and healing forests. Currently, seven healing forests are available for short-term stays.

INTERNATIONAL COOPERATION

In the 1950s, the Republic of Korea was one of the less developed countries; its per capita national income was US$67. In half a century, however, the country has achieved democratization, social stability and rapid economic development. It is, at present, the 13th largest economy (by gross domestic product) in the world (IMF, 2011). Overseas assistance such as the IBRD loan and support from the German Government, in particular for the establishment of the Forest Works Training Centre, has contributed to the successful implementation of reforestation projects.

The Government of the Republic of Korea is committed to sharing its reforestation experiences with those countries that are in need of cooperation for green growth. By sharing experiences and technologies with other countries, the Republic of Korea is now leading some climate change initiatives at an international level. One of these is the establishment of the Asian Forest Cooperation Organization (AFoCO), which will contribute to conserving the global environment, thus boosting global efforts towards achieving green growth. Another was the hosting, in 2011, of the 10th Session of the Conference of the Parties to the United Nations Convention to Combat Desertification (UNCCD COP 10). Both these initiatives are discussed further below.

AFoCO: a key engine for green growth in the Republic of Korea and the Asian region

Through the proclamation of "low carbon, green growth" as a key policy agenda for national development, a move from a conventional approach to economic and industrial development to an environmentally friendly approach to development was initiated. In order to share this vision internationally, the President of the Republic of Korea, Myung-Bak Lee, proposed the establishment of AFoCO during the Association of Southeast Asian Nations (ASEAN)–Republic of Korea Commemorative Summit in June 2009. Greening Asian forests and strengthening cooperation to address emerging forestry issues, including climate change, are the main objectives of this endeavour.

Today, about 20 percent of the world's forest cover is located in Southeast Asia, where an estimated 200 million people rely on forests and their resources (ASEAN, 2011). AFoCO will be an ideal venue for tackling forest-related issues in the region.

After the establishment of AFoCO was proposed, intensive negotiations continued between ASEAN and forestry officials from the Republic of Korea, a process that led to the signing of the Agreement between the Governments of the Member States of the Association of Southeast Asian Nations and the Republic

AFoCO

Proposed by the Government of the Republic of Korea at the ASEAN–Republic of Korea Commemorative Summit in June 2009, the Asian Forest Cooperation Organization aims to facilitate field-oriented collaborative actions primarily addressing sustainable forest management and climate change issues in the region. Activities will be related to translating sound forest policies and proven technologies into action with a mission to prevent deforestation and to rehabilitate degraded forests.

Information on the initiative can be found at: www.afocosec.org.

of Korea on Forest Cooperation, at the 19th ASEAN Summit, in Bali, Indonesia, in November 2011 (Figure 5). The Agreement represents a milestone in the history of ASEAN–Republic of Korea forest cooperation. The Agreement entered into force on 5 August 2012, which led to the launching of the AFoCO Secretariat in Seoul in September 2012.

In addition to forestry cooperation activities between ASEAN and the Republic of Korea, the Agreement provided a legal platform for dialogue towards the establishment of AFoCO, which is expected to be realized two years from the entry into force of the Agreement. Third-party countries other than the ASEAN Member States and the Republic of Korea are also expected to be involved as members of the Organization.

AFoCO will be established as a legal regional entity under an intergovernmental multilateral arrangement involving ASEAN member states, the Republic of Korea and other Asian countries. The Organization's vision and areas of cooperation are illustrated in Figure 6.

UNCCD COP 10 and the Changwon Initiative

In 2011, the Republic of Korea hosted UNCCD COP 10 in Changwon. During the event, the government proposed the Changwon Initiative, which was welcomed and endorsed by the country Parties. The objective of this initiative is to complement UNCCD's ten-year strategic plan and framework to enhance the implementation of the Convention (2008–2018) through target-setting and the consolidation of effective partnerships. One of the main components of the Changwon Initiative is the Land for Life Award, which is expected to raise awareness of the importance of sustainable land management and encourage cooperation at all levels on initiatives to promote sustainable land management.

Also envisioned in the Changwon Initiative is the establishment of the Greening Drylands Partnership among developing countries. The Partnership seeks to address the mitigation of desertification, land degradation and drought at the global and subregional levels. Activities through the partnership involve promoting community forestry for enhanced ecosystem services and local livelihoods, improving capacity-building on sustainable land management practices, and aligning with national action programmes. A separate, subregional partnership, the Northeast Asia DLDD (desertification, land degradation and drought) Network, promotes cooperation in controlling and preventing dust and sandstorms, as well as mitigating desertification, land degradation and drought, in the Northeast Asian region.

Changwon Initiative

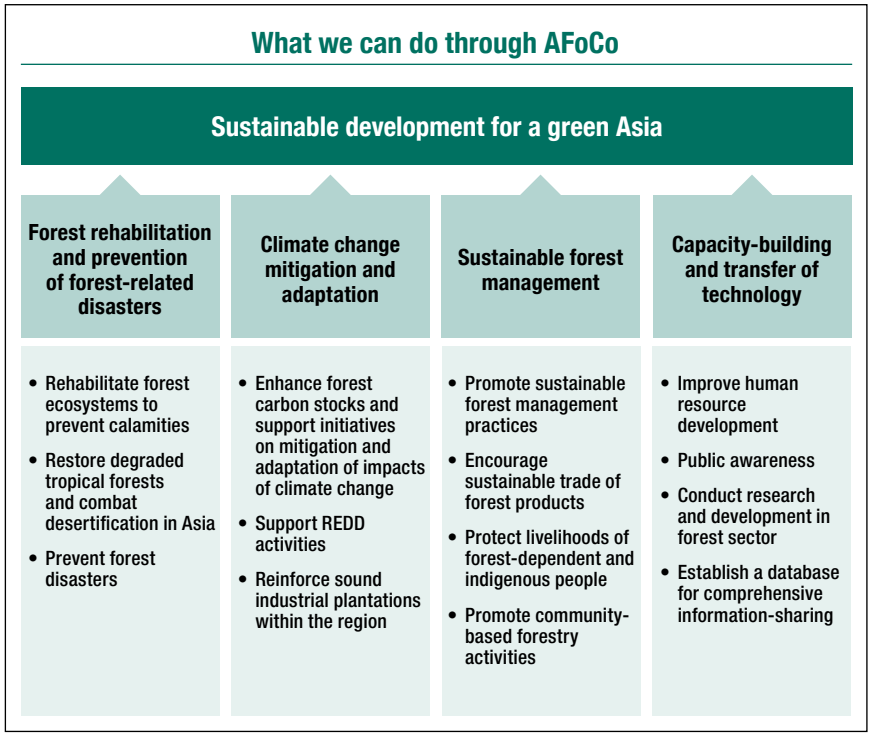
Proposed by the Government of the Republic of Korea at the 10th Session of the Conference of Parties to the United Nations Convention to Combat Desertification in Changwon, Republic of Korea, in 2011, the Changwon Initiative aims to complement the ten-year strategic plan to enhance the implementation of the Convention through target-setting and the consolidation of effective partnerships.

Full documentation on the Changwon Initiative can be found at: www.unccd.int/Lists/OfficialDocuments/cop10/misc5rev4eng.pdf.

CONCLUSION

Evolution of National Forest Plans over time

The Republic of Korea acknowledges that forests are a key resource for the implementation of the government policy on "low carbon, green growth". The government has demonstrated its commitment to the forest sector over the past 60 years, particularly through a series of intensive National Forest Plans, which have evolved over time to reflect changing situations. Whereas the First and Second National Forest Plans focused on rehabilitation


What we can do through AFoCo
Sustainable development for a green Asia
Forest rehabilitation and prevention of forest-related disasters
Climate change mitigation and adaptation
Sustainable forest management
Capacity-building and transfer of technology
• Rehabilitate forest ecosystems to prevent calamities
• Restore degraded tropical forests and combat desertification in Asia
• Prevent forest disasters
• Enhance forest carbon stocks and support initiatives on mitigation and adaptation of impacts of climate change
• Support REDD activities
• Reinforce sound industrial plantations within the region
• Promote sustainable forest management practices
• Encourage sustainable trade of forest products
• Protect livelihoods of forest-dependent and indigenous people
• Promote community-based forestry activities
• Improve human resource development
• Public awareness
• Conduct research and development in forest sector
• Establish a database for comprehensive information-sharing

6
Vision of the Asian Forest Cooperation Organization

and restoration of degraded forests, later National Forest Plans highlighted the efficient use of forest resources. Given the particular challenges at hand in the country, such as the ageing of the population, it has become evident that there is a need to strengthen the nation's development and quality of life.

With the current Fifth National Forest Plan, the Korea Forest Service is striving to build a sustainable green nation in line with the national strategy of low carbon, green growth through sustainable forest management.

Lessons learned from the past for a sustainable future

The Republic of Korea is building on its successful reforestation, having planted approximately 12 billion trees. The transition to a green economy is well under way, with long-term investments in the forest sector and the comprehensive implementation of forest policies reflecting changes over time at the national level. The Korea Forest Service is taking the lead in green growth through the sustainable management and conservation of forest resources, as well as by promoting the use of forest biomass. By establishing AFoCO and implementing the Changwon Initiative, the Korea Forest Service is fulfilling its commitment to share Korea's experiences and knowledge with the international community. ◆

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Forest certification and the green economy

M.K. Muthoo

More investment in forest certification could pay dividends in the quest for a more prosperous, sustainable world.

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Forest certification is a soft policy instrument that seeks to use assessments of forest management, the verification of legality, chains of custody, ecolabelling and trademarks to promote the sustainable management, conservation and development of forests in a holistic manner without compromising the rights, resources or requirements of present and future generations. It aims to encourage ethical trade and commerce and improve market access through the economically viable, environmentally appropriate and socially beneficial management of trees, forests and related renewable resources. Forest certification, therefore, can be a pragmatic instrument for harnessing market forces, public opinion and civil

The ultimate objective of forest certification should be to "improve the quality of life without using up an unsustainable share of the planet's resources"

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society in support of sustainable forest management (SFM).

SFM systems supported by forest certification conform with the green economy paradigm because they appropriately balance the social, economic and environmental dimensions of development. Forest certification (and associated chain-of-custody – CoC – certification) is developing into a prerequisite for public procurement and market access, and has become associated with ethical trade and social responsibility.

Certification can play an important role in combating climate change and sustaining the livelihoods of forest-dependent people. It can ensure the maintenance of ecologically important forests as safety nets that conserve gene pools and support food security and as sustainable sinks for capturing and storing carbon dioxide. It can help ensure the provision of forest biomass as a renewable carbon-neutral energy source and as a substitute for carbon-intensive building materials, such as steel and cement, thereby lowering the carbon footprint and contributing to a greener economy. Certification can also help ensure that forests are not only well-managed but also properly valued by markets. Healthy forests and their sustainable management, assured by forest certification, can contribute to the goals of the multilateral environmental agreements and to poverty alleviation and green growth.

The ultimate objective of forest certification should be eco-affluence – that is, to help make it "possible to immensely improve the quality of life without increasing greenhouse gases or using up an unsustainable share of the planet's resources" (Martin, 2011). Forest certification systems must continue to evolve, to think beyond Rio+20 and to incorporate pertinent Millennium Development Goals and the adaptation to and mitigation of climate change as explicit criteria. A ten-point forest certification charter has been drafted accordingly and was showcased at Rio+20, at which FAO's forestry side-event had the theme "forest certification: a paradigm shift in a green economy". But spreading the influence of certification, especially in the tropics, will need more investment.

A BROAD TOOL

Forest certification is a third-party process of standards-setting for performance requirements and management systems. Standards-setting is a multi-faceted process involving the custodians of the forest and related resources, owners, workers and managers, local communities and societies, retailers and consumers, producers and processors, business, and civil-society organizations. Harmonized standards are required to bring synergy between the various stakeholders and their diverse expectations regarding economic return, the environment and social justice. The accreditation of certification bodies is designed to ensure the reliability and consistency of the assessments they undertake.

Forest certification systems require periodic monitoring and assessment for improving and adapting the principles, criteria, indicators and standards for certifying forest management units (FMUs): certification could lose its effectiveness if its requirements are unreasonable or if it serves, for example, only the boutique end of the market (Muthoo, 2001). It could also lose credibility if its demands are insufficiently rigorous, or if its criteria are stagnant in the face of changing conditions.

Compliance with standards for SFM certification requires, among other things, recording forest flora and fauna, monitoring ecologically important forest areas, deploying reduced impact logging,

FAO/K. BISHT

Community (panchayat) forest, dominated by chir pine (*Pinus roxburghii*), India. The international donor community should consider greatly increasing investment in promoting forest certification and related ecolabelling in the global South

Interest in certification is growing in China, potentially affecting millions of forest farmers, such as these members of a forest farmer cooperative

FAO/E. MULLER

building public–private partnerships, and the equitable sharing of benefits among stakeholders. If it brings tangible benefits to local communities and certified FMUs, forest certification can be an effective tool for promoting sustainable livelihoods, safeguarding the biodiversity of ecosystems, combating climate change and reducing carbon emissions through avoided deforestation and forest degradation (REDD+).[1]

Forest certification can serve as a backstop for the verification and monitoring of projects on REDD+ and payments for ecosystem services (PES), which would translate into opportunities for new resources for the conservation and restoration of forests (Muthoo, 2012). Mainstreaming forest certification should thus be at the top of the sustainability agenda.

GLOBAL REACH

More than 120 countries have some form of forest certification, many with their own national systems. There are two global forest certification schemes: the Forest Stewardship Council (FSC), and the Programme for the Endorsement of Forest Certification (PEFC). These two schemes involve a total of 31 263 CoC certifications and 149 million hectares (ha) and 245 million ha of certified forests, respectively (FSC, 2012; PEFC, 2012). The FSC provides centralized accreditation for its certification, while the PEFC supports recognized national accreditation bodies. In some countries, forests may be certified by both the FSC and a PEFC affiliate, such as the Sustainable Forestry Initiative in the United States of America.

The area of certified forest expanded by 8 percent between 2009 and 2010 (UNECE, 2010) and by 12.6 percent between 2010 and 2011. More than 30 percent of the world's industrial roundwood supply is now sourced from certified forests, and the certification of related products, including paper, pulp, panels and plywood, is also increasing. The number of CoC certifications rose by 88 percent between 2009 and 2010 (UNECE, 2010), with 3 000 new certificates issued in 2011.

There is increasing interest in developing national forest certification standards. Australia, Brazil, Chile, Indonesia and Malaysia, among others, already have operational national forest certification standards, and Gabon recently completed a process to develop its national forest certification scheme. China has initiated intensive work on a national forest certification scheme and related standards. China is a huge timber importer and the world's largest exporter of secondary processed wood products, with a value estimated at around US$17 billion per year (ITTO, 2010). There has been an upsurge

[1] REDD+ is being developed to encourage developing countries to contribute to climate change mitigation through the following activities: reducing emissions from deforestation and forest degradation; the conservation of forest carbon stocks; the sustainable management of forests; and the enhancement of forest carbon stocks.

FAO/A. LEBEDYS

A red ironwood* (Lophira alata) *log marked and tagged for chain-of-custody purposes in Zogabli, Grand Bassa County, Liberia. Worldwide, the number of chain-of-custody certifications rose by 88 percent between 2009 and 2010

in FSC and PEFC CoC certifications in China, which will lead to greater demand and reward for its certified wood products worldwide. India's imports are skyrocketing, having doubled between 2005–06 and 2010–11, to about US$2 billion, with a growing gap between demand and supply (Muthoo, 2006; 2011). The next section presents a synopsis of the situation in the global South,[2] where forest certification is not as widespread as it is in Europe, elsewhere in the global North, and in emerging economies.

THE GLOBAL SOUTH

The global wood industry is economically important to the global South. The annual turnover of wood products, including pulp and paper, exceeded US$200 billion in 2007, with developing countries accounting for over 17 percent of the trade. The value of annual tropical timber exports was over US$20 billion (Blaser *et al*., 2011). The production and export of products by the global South, such as plywood and veneers, have grown threefold in the past 30 years.

Removing barriers to the market entry of forest products from the global South can be an ingredient in poverty-reduction strategies. Forest certification must take up this issue and strengthen the global South's role in international trade, given its inherent comparative advantage, as demonstrated by tropical timber exports from Cameroon, China, Gabon, Ghana, Guatemala, Malaysia and Viet Nam, and plantation products such as pulp, paper, particleboard and medium-density fibreboard from Brazil and China. This recognition can contribute to green jobs and the generation of income, to SFM by preventing the degradation of biodiversity-rich natural forests, and to ethical trade, by preventing illegal logging. All these outcomes are in the interests of all countries.

Many countries in the global South are encouraging forest certification and labelling to increase the market acceptance of their products worldwide. They are motivated by ongoing and emerging issues of forest law enforcement, governance and verifying the legality of timber trade (collectively referred to as FLEGT); green economy procurement policies; REDD+ potential for forest restoration and conservation; the scope for eco-development and PES, including water and renewable energy; and the need to certify farm forestry and planted and smallholder and community forests. China has announced that all its exporters of wood products must have CoC certificates by 2020. This will be a huge driver of CoC growth, as will the European Union's due diligence requirements for imports.

Barely five percent of certified forests worldwide is in the global South. Nevertheless, the extent of certified forest there is expanding – from 6.4 million ha in 2002 to over 20 million ha towards the end of the decade (UNECE, 2010); the area of certified forest in the main tropical forest countries of Africa more than tripled between 2005 and 2010, to 4.63 million ha (Blaser *et al*., 2011). Almost 80 percent of certified forests in the global South are natural forests, and a study of 123 evaluations in 24 tropical countries found that forest management improves soon after the forest certification process is launched (Peña-Claros, Blommerde and Bongers, 2009). This is because the process requires, among other things, upfront engagement with forest stakeholders and the baseline assessment and monitoring of biodiversity, productivity and forest cover.

Despite considerable potential to expand the area of certified forest in the global South, there are many obstacles, including limited domestic demand for certified products, the incompatibility of certification standards with local legal frameworks, weak governance, and barriers to adoption by small landholders and forest communities, especially those without clear title or tenure. Moreover, the cost of certification and a lack of know-how are huge hurdles for tree farmers,

[2] The term 'global North' is used to refer to wealthy, or 'developed', countries, and is not wholly defined by geography. 'Global South' refers to tropical forest countries and other 'developing' countries.

woodland owners and public forest custodians in many countries in the global South. A significant increase in the area of certified forest in such countries will require not only an increase in the demand for certified wood but also technical and financial assistance (Peña-Claros, Blommerde and Bongers, 2009).

CHALLENGES AND OPPORTUNITIES

Credible forest certification can unite stakeholders in a quest for an inclusive green economy. It can address fair trade, the need to balance the social, cultural, economic and environmental dimensions of development, and environmental concerns for the biodiversity- and carbon-rich forests of the global South. Appropriately evolved forest certification can be used as a tool in REDD+-related strategies and PES to address climate change and to benefit local forest stewards. Dynamically adapted forest certification systems can backstop efforts to erode persistent poverty, which is both a cause and a consequence of deforestation and forest degradation.

Phased approach

Developing fully fledged national certification systems is both time-consuming and costly. One way to address this challenge is to adopt a roadmap that uses a phased approach, in which certification standards need not be cast-iron measures of sustainability but rather evolving tools of adaptive management (Muthoo, 2009). Such an approach enables convergence between forest certification and initiatives to verify timber legality and would encourage learning-by-doing while also offering tangible benefits to forest producers by increasing market access for their products.

Non-wood forest products

To date, forest certification has focused largely on wood products, but it is also relevant to non-wood forest products (NWFPs). Millions of the poorest of the poor derive their livelihoods from NWFPs, which have untapped benefit-sharing potential that could be realized through certification (Yadav, Kotwal and Menaria, 2007). This is particularly significant for internationally traded and niche market products handled by local communities, such as Brazil nuts, bushmeat, bamboo baskets, mats and handicrafts. In the poorest Indian state, Odisha, pickers of siali leaf (*Bauhinia vahlii*) have benefited from labelling leaves and receiving multiple price premiums (Sasmal, 2008).

Small-scale operators

User groups that need special consideration include farm foresters, women workers, forest-fringe villagers, forest-dwellers and indigenous groups. Forest certification systems must be synergized with innovative institutional support, such as good

FAO/I. MASUCH

Non-wood forest products, such as these Brazil nuts from Brazil, have considerable benefit-sharing potential that could be realized through certification

governance and dedicated chambers for gender-balanced community and indigenous groups. Environmental, economic and social chambers should also have an appropriate balance of interests. Such measures would help ensure that certification can cater to forest rights given the ground-level realities in FMUs and that no party receives more or less than is equitable.

There have been positive moves in this direction, such as the adoption of codes of harvesting practice (Muthoo, 2003) and simplified procedures for developing national forest certification standards. Measures to make certification more attractive and less costly are critical. Engaging local small-scale stakeholders is also essential if certification is to be a mechanism for improving equity. Cooperatives can increase the marketability of certified products, and group certification is another option. An additional innovation could be to combine certification for the production of timber and NWFPs with PES and related landscape labelling (Ghazoul, 2011).

Capacity-building and support

The costs and benefits of certification, such as a small, or no, price premium for certified products, can be approached by stakeholders from varying perspectives. The profitability of certified products will influence the marketing strategies, entrepreneurship and stewardship of forest custodians, communities and companies. There is a need to strengthen institutions, policies and legislation to reduce the gap between current standards of forest management and certification requirements, so that certification delivers due rewards to forest stewards, especially in recognition of their contribution to SFM, forest law enforcement and legality.

In many tropical forests there is a big gap between existing management and what is required for certification. Bridging this gap warrants international recognition and investment to strengthen capacity and promote better management. The international donor community in particular should consider greatly increasing investment in promoting forest certification and related ecolabelling in tropical forests (Muthoo, 2001); at the national level, public-sector and private-sector organizations could contribute to and help deliver such investment.

Forest law enforcement and governance

Another challenge is ensuring the legality of timber. Illegal logging generates illicit earnings of US$10–15 billion annually, including the huge underpayment of royalties and taxes (Goncalves *et al*., 2012). This estimate does not capture the enormous environmental and societal costs associated with illegal logging, with criminals profiting at the expense of the poor and the environment. Illegal logging stifles sustainable development and distorts the marketplace, discouraging legitimate forest enterprises from investing in good forest management and undermining attempts to achieve forest certification and SFM.

The legality of timber production and trade is "an essential pre-requisite" for achieving SFM (van Dam and Savenije, 2011). It must be addressed upfront in forest certification, even if a phased approach is used to roll out certification practices. An effective criminal justice plan should be an integral part of any strategy, so that forest crime can be addressed in parallel with preventive programmes of forest certification. The two approaches should be mutually reinforcing, so that both help to increase the effectiveness of FLEGT. Forest officials and policy-makers need a comprehensive understanding of the positive impact of an integrated criminal justice strategy on combating illegal logging; a forest-certification-related legality dimension can be a key component in FLEGT systems. Meanwhile, emerging legislation, such as the 2008 amendment to the Lacey Act in the United States of America, which broadened activities banned by the Act to include commerce in illegal timber and wood products, and the European Union Timber Regulation, which sets out the obligations of operators in the timber market to avoid trade in illegal products, will help drive certification forward.

MULTISTAKEHOLDER SYNERGIES

The motives and interests of the various stakeholders in forest certification are rarely fully mutually reinforcing. There are many potential conflicts: for example between local communities, traders and consumers, between those who incur costs and those who receive benefits, and between big and small operators, North and South, and global and national certification systems.

Certification also has many potential beneficiaries. For those whose main concern is the environment, it can be a means to influence how forests are managed and to promote biodiversity conservation. For social movements, it can be an opportunity for benefit-sharing and recognizing the role and responsibilities of local communities. For industry and trade, it can be an instrument for branding and marketing and for buyers and consumers it can provide credible information about products they purchase. For forest owners and managers, it can be a tool for market access and advantage. For governments and civil society, it is a soft policy instrument to promote SFM and sustainable consumption patterns. Certification has to take into account all these sometimes divergent values, interests and goals.

CONCLUSION

Forest certification and related eco-labelling are innovative policy instruments for assuring the sustainability and multifunctional role of forest assets for human well-being. Forest certification needs to be reinvigorated, however, so that it continues to contribute concomitantly and increasingly to the vision of a green economy. We must not miss the opportunity presented by certification as an agent of sustainability, equity and justice in forests and related industries. Innovative people–public–private partnerships for eco-affluence and a green economy must be built, globally and locally.

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Addressing the safety of forest workers

C. Peirano

In Argentina, a national training programme has halved work-related accidents in the forest.

Forest-based employment may be thought of as a "green" job – work that contributes substantially to preserving or restoring environmental quality (UNEP, 2008). Nevertheless, the working conditions of many people employed in the forest sector are still far from adequate. Ensuring worker safety and welfare is critical if the forest sector is to provide "decent" jobs[1] and to serve as a development tool for a sustainable future.

Forest work is considered among the most hazardous in the world (UNEP, 2008). The International Labour Organization (ILO, 2011) recently recommended that both training and social dialogue be improved to break the vicious circle of low productivity, low wages and high accident rates that characterize the forest sector. Among other things, it proposed that social dialogue be promoted to create an enabling environment for labour unions, employers' associations and collective bargaining practices and to ensure that relations between workers and management are based on regular consultation and fairness on both sides.

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[1] The ILO defines decent work as productive work in conditions of freedom, equity, security and human dignity, with the protection of rights, the delivery of a fair income and the provision of social protection.

Previous page: Chainsaw operators in native forest. They have highly dangerous jobs, and much more attention to their safety is needed. The often informal nature of their employment, however, hinders improvement

This article describes a process along these lines in Argentina's forest sector,[2] where the incidence rate of forest accidents[3] was cut in half between 2004 and 2010. During this period, efforts were made to improve ongoing training and social dialogue – as per the ILO recommendation – in order to reduce the high rate of occupational accidents in the sector.

FOREST WORK IN ARGENTINA

Argentina has approximately 30 million hectares (ha) of native forest and 1.2 million ha of planted forest. About ninety-five percent of the forest industry's timber supply is obtained from planted forests. An average 38 000 ha of planted forest were established (with exotic species, mainly pine, eucalyptus and willow) each year in the period 2005–2010 (FAO, 2010), while the average annual timber harvest was about 11 million m^3 (Argentine Forest Association, 2012). According to FAO (2010), 32 000 people were employed in the forest sector in 2000, the most recent year for which an estimate is available.

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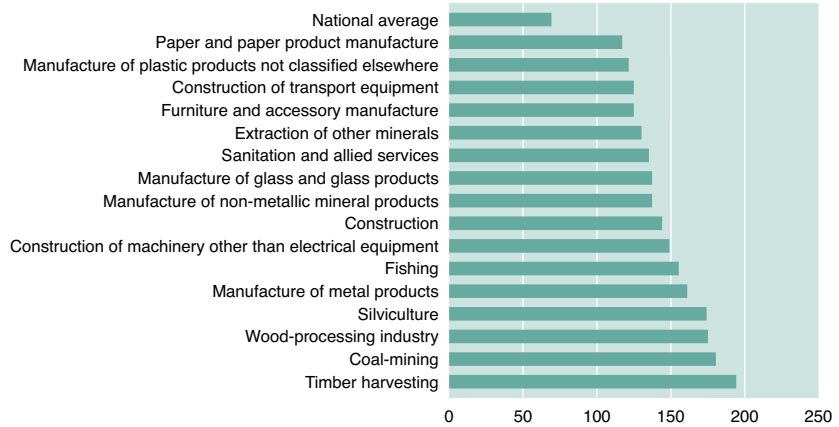
Workshops were held to, among other things, develop standardized job categories in the forest sector

Forest work is characterized by high informality and low worker safety, with the most hazardous jobs carried out by people with little formal education. According to data from the Supervisory Authority for Occupational Risks (SRT), the sector formally employed an average of 9 200 people during the 2003–2010 period. If the estimate of a total workforce of 32 000 is correct, two out of every three forest jobs are informal. This figure is high, but it is in line with ILO's estimates that 66–72 percent of all workers globally are employed informally (ILO, 2011). In the forest sector, it is estimated that the majority of informal work is associated with native forests. Almost 40 percent of formal forest employment is in Misiones, the country's main forest-industry province (SRT, 2007).

According to SRT (2007), the forest-related activities of silviculture, wood product industry (i.e. wood processing) and timber harvesting were three of the four most hazardous occupations in the three-year period 2002–2004 (coal-mining being the other in this group). The reported figure of 195 accidents per 1 000 workers in timber harvesting made that subsector the most hazardous in the country (Figure 1).

The informality and high occupational risk of the forest sector are compounded by the high social vulnerability of workers.

1
Ranking of the 16 activities in Argentina with the highest workplace accident rates per 1 000 workers for the 3-year period 2002–2004



Source: SRT, 2007.

[2] The programme described in this article encompasses not only forest operations such as silvicultural operations and timber harvesting but also the wood-processing industry. However, this article focuses on labour conditions in forest operations.

[3] The incidence rate refers to the number of reported cases of accidents in the workplace per 1 000 workers (not including accidents incurred on the way to or from work) during the calendar year. See www.srt.gob.ar for more information.

For example, a recent study revealed that 78 percent of surveyed chainsaw operators had only primary-school education, in most cases incomplete, and their wages were the main source of household income (Peirano, Bustos and Nahirñak, 2009).

Informality, low educational levels and a work environment involving hazardous activities, often in remote areas, present major challenges for improving job safety and providing forest-sector workers with job security. Forest workers have little hope of a sustainable future without safe, decent, reliable work.

Tackling this issue in the forest sector – and especially in timber harvesting – was given high priority by the Argentine Forest Association (the main association of Argentina's forest enterprises) and the Argentine Union of Rural Workers and Stevedores (UATRE, the main union of forest-sector workers). These two bodies saw an opportunity in the launch of a state-funded programme by the Ministry of Labour, Employment and Social Security (MTEySS) in 2004 to certify labour competencies and training. The aim of the Labour Competencies Certification and Lifelong Training Programme is to ensure that workers in any sphere have appropriate training, thereby reducing the level of occupational risk, increasing employability and allowing the spread of better practices in the sector (Peirano, Bustos and Nahirñak, 2009).

Labour Competencies Certification and Lifelong Training Programme

The Labour Competencies Certification and Lifelong Training Programme is designed to obtain the active participation of organizations representing employers, unions and academics based on guidelines laid down by MTEySS. The forest sector was one of the first sectors in which key bodies signed a framework agreement for implementing the programme.

Under the programme, jobs are standardized, evaluation tools are developed in accordance with norms, evaluators are trained, workers are evaluated, those demonstrating the necessary competencies receive certificates, and a curriculum and teaching materials for training are developed. Certification bodies were established for the forest sector coordinated by business representatives from the Argentine Forest Association, UATRE, and equivalent bodies for fire management (the National Fire Management Plan) and timber and furniture (business and workers' associations for the timber sector). The National Council for the Labour Competencies Certification and Lifelong Training Programme was established in collaboration with these institutional representatives, and a network of forest-sector, timber and furniture training institutions was created.

The main features of the programme are:

- *state policy:* promoted by MTEySS and involving a technical team that will remain in place for an 8-year period;

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Tree-pruners in Patagonia, Argentina: tree-pruning is one of the standardized job categories for which ongoing training, curricula and teaching materials have been developed and instructors trained in their use

A team of firefighters awaits evaluation as chainsaw operators, an important part of their skill development

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- *competencies:* following ILO guidelines on the development of competencies, which entail standardization, worker certification and ongoing training;
- *social dialogue:* carried out by representatives of business and workers' associations, with the support of MTEySS and requiring the active involvement of the principal managers and supervisors of workers involved in the programme;
- *territory-based nature:* although national in scope, actions under the programme are concentrated where significant forest-sector activities are located;
- *workers' certification:* allows the recognition of workers' knowledge and is used in designing workers' training and professional qualifications;
- *lifelong training:* the ultimate goal of the programme – the continuing training of workers to a standard validated and legitimized by business and unions;
- *institution-building:* includes competency-based training for teachers.

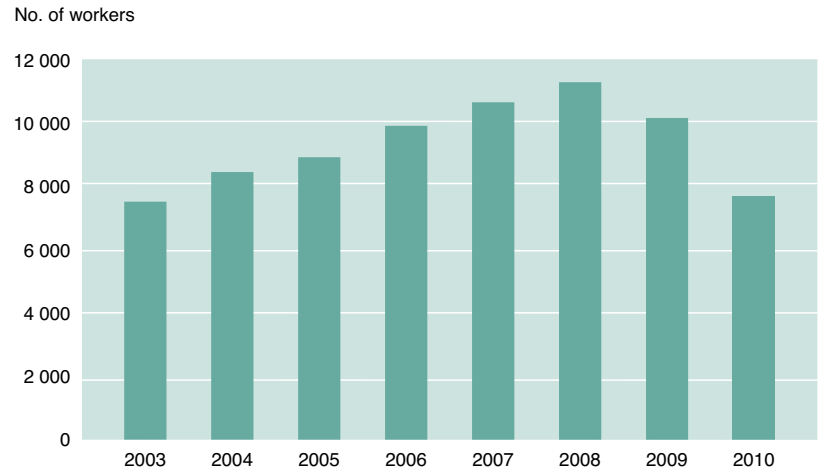
By the end of 2011, eight forest-operations job categories had been standardized (firefighter, chainsaw operator, agrochemical preparer and applier, planter, pruner, freight machine operator, harvesting supervisor and forestry supervisor), 52 evaluators had been trained and approximately 3 500 workers had been evaluated. According to data from MTEySS, between 2004 and the end of 2011 about 3 200 workers in those job categories had been trained with programme funds and the remainder had been trained with supplemental funding from enterprises. Ongoing training, curricula and teaching materials had been developed for the eight standardized job categories, and about 20 instructors had been trained in their use.

The programme attracted significant participation from forest-sector employers and union officials. The standardization process was carried out with the involvement of leading enterprises in the sector, which collaborated by identifying experienced workers and supervisors. Using guidelines provided by MTEySS, the standardization process, which was carried out in collaboration with the region's main training institutions, took about three months for each job category and involved workshops, interviews and field trips. Each standard was validated in a workshop with the participation of counterparts from employers and unions.

Special care was taken in identifying evaluators for training; they needed to have had more than five years' experience, including in staff management. The human resource managers and owners of contracting companies were invited to the evaluator-training workshops in order to raise their awareness and involve them directly in the process.

This process was initially supported by medium- and large-sized forest enterprises (mainly those based in the planted-forest estate) with either environmental certification (for example ISO 14000) or forest management certification (e.g. the Forest Stewardship Council) and located in the main forest zone (Misiones and Corrientes). Later, smaller forest enterprises became involved, particularly forest-service contractors. By the end of 2011, workers from 12 of Argentina's provinces had been evaluated.

In every case, the scope of the programme was confined to formally employed planted-forest workers. This limitation was a concern, and with a view to including native-forest workers, evaluations were later carried out in the



Source: Based on Supervisory Authority for Occupational Risks data (available at www.srt.gob.ar).

2
Number of forest workers with insurance cover for occupational risk: Argentina, 2003–2010

country's north (Chaco and Formosa, with visits to Salta and Jujuy). These evaluations showed that the situation of workers in those areas was precarious and that the first action should be to provide training so that safety standards could be adopted before a start was made on certifying the competencies of workers. The informal nature of employment was seen as a constraint.

The situation in Chaco was eased by the signing of a Workers' Co-responsibility Agreement by a local employment association, UATRE, the Government of Chaco and MTEySS, facilitating the formalization of employment, starting in 2010. This move provided incentives for launching a major training process, together with institution-building for ongoing training, in 2011. The impacts of these recent actions have not yet been analysed.

IMPACTS OF THE PROGRAMME

The reach of the overall programme was good: by the end of 2011, about 30 percent of formally employed forest workers had been evaluated, and it is estimated that more than 50 percent had received competencies training. The next question is whether the process has affected the incidence of forest accidents in the six years since this major public programme got under way.

Change in coverage for occupational risk

The registration of forest workers for labour risk insurance cover, an indicator of formal employment, increased by 47 percent between 2003 and 2008, from 7 601 to 11 186 individuals (Figure 2). This increase was reversed in the following two years: in 2010 the number of registered workers was similar to the 2003 figure. This latter decrease reflects, in part, an overall decline in the economy, but it also had structural causes.[4] For example, the 2008 global financial crisis hit the international timber market hard, reducing activity, and there has also been a major recent expansion in the mechanization of forest harvesting.

Changes in the incidence of work-related accidents in the forest sector

Figure 3 shows a dramatic (49 percent) decline in occupational accidents in timber harvesting between 2003 and 2010. In 2003, there were 198 accidents per 1 000 workers, with a rate of occupational risk almost double that of the agriculture sector and more than three times the national average. In 2010, 101 accidents were reported per 1 000 workers, bringing the forest sector close to the average for agriculture and to less than double the national average. In the same period, the overall national rate of work-related accidents fell by 10 percent, while the rate in the agriculture sector fell by 15 percent. Throughout the period, 93 percent of reported forest accidents entailed a loss of working days and/or resulted in incapacitating injury.

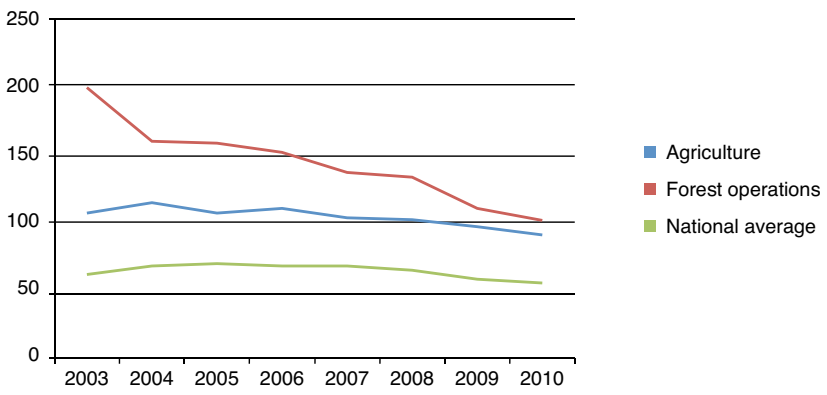
Table 1 shows that the largest reductions in work-related accidents between 2003 and 2010 took place in forest services (50 percent reduction), forestation, and felling and rough dressing of trunks and timber (both 47 percent), while other forest operations (which include charcoal production and forest tree nurseries) showed a reduction of 20 percent. It should be noted

TABLE 1. Incidence of work-related accidents for various types of forest work: Argentina, 2003–2010

Description	2003	2004	2005	2006	2007	2008	2009	2010
	Incidence (per 1 000)							
Forestation	122.7	111.2	150.2	130.0	118.9	115.4	86.0	67.8
Forest services	260.0	190.2	168.4	164.0	162.2	166.2	136.5	129.6
Felling and rough dressing of trunks and timber	183.3	193.1	181.3	173.6	125.6	92.2	89.8	100.1
Other forest operations	109.2	124.8	121.5	122.6	96.4	107.2	95.0	87.3

[4] Unpublished survey carried out by the author among major forest-sector companies in February 2012.

3
Incidence of work-related accidents per 1 000 workers in the agriculture and forest sectors and national average, Argentina, 2003–2010



Source: Based on Supervisory Authority for Occupational Risks data (available at www.srt.gob.ar).

that the standardized jobs correspond to the first three groups of workers.

The reduction in work-related accidents started in 2004 for forest services, in 2005 for felling and rough dressing of trunks and timber, and in 2006 for forestation. Note, however, that data for the period do not indicate any improvement in the percentage of formal employment in the sector.

CONCLUSION

This article has shown that Argentina's formal forest sector was able to achieve a steady fall in work-related accidents in forest operations – almost five times the national fall – between 2004 and 2010. The reduction in the accident rate coincided with the launch and implementation of the Labour Competencies Certification and Lifelong Training Programme, which, among other things, instituted a dialogue among employers, workers and academics.

It is estimated that the programme was able to evaluate about 30 percent of formal workers, the group for which statistics are available regarding work-related accidents. A specific study would be needed to establish causality; for example, the trend towards greater mechanization in timber harvesting might have had some impact on accident rates. Nevertheless, the data presented here are encouraging, and the country's experience can be taken as a positive example for regions wishing to put in place a systematic approach to tackling work safety and providing ongoing training to forest workers.

Various factors were involved in the success of this approach: the early involvement of the forest sector's leading enterprises and training institutions, support from

Forest workers pose before evaluation under the responsibility of the workers' union, UATRE

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A chainsaw operator refuels during an evaluation exercise

union representatives, a focus on building relevant competencies, and clarity regarding the objectives of MTEySS for the programme.

Certification met with rapid acceptance in the formal sector, especially among workers involved with planted forests, but it has been more difficult to achieve in areas in which informality of employment is more the norm. With the standardization of jobs, training can lead to the adoption of safety standards and help transfer skills to workers in regions with the highest incidences of informality. However, such efforts will be of limited effectiveness if working conditions are not improved and informality itself is not reduced.

The reduction in occupational risk achieved in Argentina between 2004 and 2011 shows that the forest sector is capable of generating safer jobs. If the sector is to play its potentially significant role in providing green, decent jobs as part of a sustainable future, the further formalization of employment is necessary. ◆

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Integrating forestry, sustainable cattle-ranching and landscape restoration

Z. Calle, E. Murgueitio and J. Chará

Z. CALLE

A proposed new image of tropical cattle-ranching involves animals grazing in a shaded and biologically diverse environment, surrounded by high-quality edible biomass. These bulls graze under a rain tree* Albizia saman *at the El Hatico Reserve, El Cerrito, Valle del Cauca, Colombia

This example of natural intensification can simultaneously improve a farming system, generate environmental goods and services and facilitate the release of fragile, marginal and strategic areas for strict conservation.

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The livestock sector occupies about 30 percent of the land surface of our planet through grazing and feed-crop production. It is a leading driver of deforestation, land degradation, pollution, climate change, the sedimentation of coastal areas and invasions by alien species (FAO and LEAD, 2006). The link between livestock production and deforestation is strongest in Latin America, where cattle-ranching activities have expanded, mostly at the expense of forests. A simplified form of cattle-ranching based on grass monocultures has been practised for centuries in Latin America. This type of system has promoted environmental degradation and climate change because it goes against the natural dynamics of tropical forest ecosystems[1] (Wassenaara *et al*., 2007).

A paradox of cattle-ranching in Latin America is that, even though it is currently

[1] In tropical forest ecosystems, most nutrients are locked in living plants, animals and microorganisms. Closed nutrient cycles are promoted by a highly diverse vegetation with dense networks of fine roots and mycorrhizal associations, coupled with efficient decomposer assemblages.

L. SOLARTE

Cattle can help support complex soil food webs and restore fertility in degraded lands, such as here in the Cesar River valley, Cesar, Colombia

the principal land use, occupying more than 550 million hectares (ha), its average stocking and productivity rates are low (0.59 animals per ha, and 19.9 kg of beef or 89.7 litres of milk per ha per year, respectively; FAO, 2006). With some exceptions, this land use has minimal per-animal and per-ha production indexes and makes a meagre contribution to rural employment in the region.

Despite its inefficiency and its multiple negative effects on the environment, cattle-ranching is not likely to decline any time soon in Latin America. First, this activity is deeply rooted in the Portuguese and Spanish ancestry of the region. Second, a high and growing demand exists for all cattle products. Third, the activity has often been undertaken as a reaction to agricultural failures that result from biophysical constraints (Hernández, 2001; Murgueitio, 2005). Finally, over time, it has become instrumental as a means to consolidate land control (Murgueitio and Ibrahim, 2008).

However, tropical cattle-ranching activities can be improved and need not be destructive. Cattle have the potential to act as "mobile sun-powered catalytic converters",[2] capable of transforming the cellulose in plant biomass into simple carbohydrates that support complex soil food webs and help restore fertility in degraded lands (Patriquin and Moncayo, 1991). Sustainably managed in silvopastoral systems and integrated with connectivity corridors and protected areas, cattle-ranching can even become a tool for landscape-scale restoration. The large-scale transition from input-intensive cattle grazing on degraded pastures to environmentally friendly silvopastures could enhance the resilience of soil to degradation and nutrient loss, sequester large amounts of carbon (1.2 to 6.1 tonnes per ha per year; Ibrahim *et al*., 2010; Udawatta and Jose, 2011), reduce greenhouse gas emissions (Nair *et al*., 2011) and contribute to the protection of water resources by improving soil properties and reducing pollution (Chará, 2010). Jobs could be created, and high-quality food and other products could be produced, in a sustainable way.

This article describes ways to harness the power of the existing tropical cattle-ranching systems into intensive silvopastoral systems (ISPSs), explores sustainable timber production in these systems, including how and why certain species are selected, and discusses incentives for implementing ISPSs.

WHAT ARE ISPSs?

Forest and landscape restoration must go beyond afforestation, reforestation and even ecological restoration to improve both human livelihoods and ecological integrity (Minnemeyer *et al*., 2011; Laestadius *et al*., 2011). Landscapes should be restored and managed for a balanced combination of ecosystem services and goods, not only for increased forest cover.

It has been suggested that a high level of food production can only be achieved in

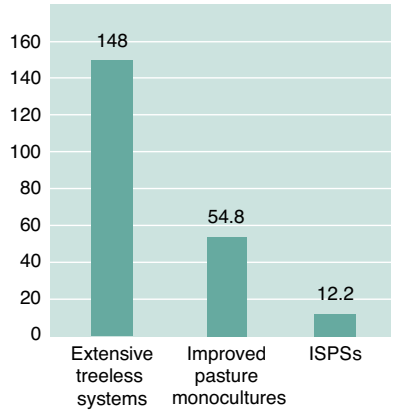
[2] Catalytic converters convert the toxic components of the exhaust of an internal combustion engine into less toxic substances.

L. SOLARTE

ISPSs combine the high-density cultivation of fodder shrubs with improved tropical grasses and trees. This ISPS in Finca San Marcos, Tamalameque, Cesar, Colombia, incorporates* Brachiaria humidicola *(grass),* Tithonia diversifolia *(fodder shrub) and* Acacia mangium *(timber tree)

chemically intensive and energy-demanding modern agriculture, which provides a low-quality habitat for wildlife, while alternative agriculture is doomed to low productivity, even if it is more biodiversity-friendly (Perfecto and Vandermeer, 2010). However, agricultural intensification and sparing the land do not necessarily constitute a dichotomy; *natural intensification* exists on the spectrum. This alternative seeks to maximize the efficiency of biological processes such as photosynthesis, nitrogen fixation and nutrient recycling in order to boost biomass production and enhance soil organic matter.

The inputs of naturally intensive systems are biological processes rather than fossil fuels and synthetic compounds, and they apply modern scientific knowledge to combine and manage species with different traits. ISPSs are a good example of natural intensification, in which the productive benefits of the system stem from the same processes that provide ecosystem services.



By replacing extensive pastures with improved pasture monocultures or ISPSs, it is possible to produce the same amount of meat in 36 percent and 8 percent of the land area, respectively (Murgueitio *et al*., 2012).

1
Land surface required to achieve an annual production of 10 000 tonnes of meat in the highly seasonal dry Caribbean region of Colombia

ISPSs are a form of agroforestry that combines the high-density cultivation of fodder shrubs (more than 8 000 plants per ha) for the direct grazing of livestock with improved tropical grasses and trees. The top vegetation layer may consist of trees or palms with densities ranging from 100 to 600 individuals per ha, in accordance with the biophysical and climatic conditions of each agroecosystem. Tree products – such as timber and fruit – may be directed to local markets, agribusiness or the protection of biodiversity (Murgueitio *et al*., 2010).

ISPSs respond to the increasingly urgent need to transform tropical cattle-ranching into an environmentally friendly activity that can be profitable in the short and medium terms and capable of generating more and better rural jobs while providing safe, high-quality food (meat, milk and fruit), hides and wood. These systems are suitable for beef, milk, dual-purpose or specialized cattle farming as well as buffalo, sheep and goats.

ISPSs should be based on solid scientific and technological knowledge (Dalzell *et al*., 2006; Shelton and Dalzell, 2007; Murgueitio *et al*., 2011; Murgueitio *et al*., 2012; Mahecha *et al*., 2012). They are being increasingly adopted in profitable and modern farms in Colombia and other Latin American countries. Because of their higher stocking density (2–5 head per ha), ISPSs allow farmers to concentrate production in the most suitable areas of their farms and release fragile lands for soil recovery and biodiversity protection (Chará *et al*., 2011). Some key features of ISPSs are high biomass production and the high nutritional quality of the fodder; rotational grazing with high stocking rates and brief grazing periods followed by long periods of plant recovery; and high per-ha productivity (Figure 1).

The proper functioning of ISPSs requires:

- a permanent supply of good-quality water in mobile troughs and mineralized salt;
- live fences planted at the periphery and internal divisions of paddocks;
- electrical fencing or tape, either fixed or mobile, to concentrate grazing on narrow strips;
- non-violent handling of livestock (Ocampo *et al*., 2011).

ISPSs combine elements of traditional livestock management, fodder banks and timber plantations, but are significantly different from these three land-use systems:

- Unlike conventional extensive cattle-ranching, ISPSs require rigorous management, administrative control and permanent adjustments based on careful monitoring. Management protocols are simple but mandatory; for example, once the system is established, fire and herbicides cannot be used. In Mexico,

the farmers who have achieved the best results owe their success to their previous experience in agriculture and, in some cases, to their training in precision agriculture (Solorio-Sánchez *et al*., 2012).

- Unlike mixed fodder banks or other cut-and-carry systems, ISPSs are designed to tolerate direct browsing by cattle. Electric fencing must be handled properly in order to guarantee the heavy but instantaneous grazing of narrow strips of shrubs and grasses in each paddock. These short rotations minimize the negative impact of cattle on the soil and facilitate the recovery of shrubs and grasses. Once the cattle have moved forward to a fresh fodder strip, dung beetles and earthworms quickly bury or degrade the dung, thus interrupting the life cycles of various parasites (Giraldo *et al*., 2011; Murgueitio and Giraldo, 2009).
- ISPSs differ from tree plantations in their lower planting densities, the spatial arrangement of trees in rows alternating with strips of pasture or shrubs, the west–east (instead of north–south) orientation of tree rows and the timing and intensity of tree thinning and pruning, both chosen to minimize pasture shading.

Silvopastoral systems can enhance biodiversity in agricultural landscapes, as revealed by an analysis of the changes in the richness of bird species following the implementation of the Regional Integrated Silvopastoral Approaches to Ecosystem Management (RISAEM) project in Quindío, Colombia. After five years, total bird richness in the project area increased from 146 to 193 species, forest-dependent birds increased from 74 to 104 species, migratory birds increased from 10 to 19 species and one endangered species recolonized the area (Chará *et al*., 2011). The diversity of ant species in silvopastoral systems was equivalent to that recorded in remnant forest. Silvopastoral systems with complex vegetation can support significant levels of biodiversity (Harvey *et al*., 2005, 2006; Sáenz *et al*., 2007) and provide ecosystem services such as natural pest management, carbon sequestration, water and soil conservation, nutrient cycling, hydrological protection and crop pollination.

M.M. MURGUEITIO

For an ISPS to function properly, certain controls must be in place. On El Chaco farm, Pedras, Tolima, Colombia, electrical tape allows grazing to be concentrated on narrow strips. Note the browsed* Leucaena leucocephala *shrubs at the front

INTRODUCING TREES AND TIMBER PRODUCTION INTO ISPSs

ISPSs can combine the short-term profit from milk and/or meat production with a long-term investment in timber.

Tree species, silvicultural treatments and agroecological factors determine timber production in ISPSs. Timber trees are planted in double or triple lines separated by 15–30 m wide grazing strips. The initial density of trees in these systems is thus half or less the density in homogeneous tree plantations. With light interception by timber trees varying between 10 and 40 percent, ISPSs permit grazing until the final harvest of the trees. Controlled grazing is allowed four to eight months after the grasses and fodder shrubs have been planted; however, entrance of the cattle to the timber lines is restricted for up to 18 months by electric fencing. After that period, animals have access to the whole ISPS area.

Depending on the species and region, timber thinning or harvest may begin at year 7, with successive harvests up to

J.E. RIVERA

ISPSs can enhance biodiversity in agricultural landscapes, such as this 2-year-old ISPS established in degraded soils of the Amazon foothills. Buenos Aires farm, El Doncello, Caquetá, Colombia

year 20–25. The total volume of wood is estimated to be 30 percent lower than in conventional plantations, but this reduction is offset by the increased price of timber at final harvest. In these systems, thinning and pruning are designed to maximize diameters above 30 cm (for pine and eucalyptus, in 15–16 years), increasing the volume of high-priced timber by 50 percent (Esquivel *et al*., 2010).

Selection of species

The livestock component of ISPSs biases the selection of trees toward nitrogen-fixing species, fruit trees that can supplement cattle nutrition and timber sources for farm use, local markets and industry.

Crown architecture is another important aspect of tree selection. In general, species with straight trunks and small crowns and that are self-pruning, such as *Cordia gerascanthus*, are preferred to highly branched trees with twisted stems. However, large nitrogen-fixing trees with edible seeds such as *Albizia saman*, *Albizia guachapele* and *Enterolobium cyclocarpum* (all in the Fabaceae family) are usually kept within ISPSs at a low density.

Species with open crowns that allow enough sunlight to reach the ground are used instead of trees with dense canopies that block sunlight. Mango trees are an exception because the benefits provided by their large crops of nutritious fruit and the increased nutrient recycling compensate for the reduced fodder production beneath their crowns. Species with small and rapidly decomposing leaflets are preferred to those with large, thick leaves that form persistent litter. *Tectona grandis* is an exception because the cattle eat some fallen leaves, while the combination of trampling and urine accelerates the decomposition of remaining leaves.

Transition from open pastures to ISPSs is often accompanied by a greater appreciation of biodiversity within the farming system. For example, some dairy farms in the central and eastern Andes of Colombia have replaced their *Pennisetum clandestinum* (kikuyu grass) monocultures with ISPSs that combine caespitose and stoloniferous grasses, creeping legumes, a middle layer of *Sambucus* species and *Tithonia diversifolia* fodder shrubs, and the nitrogen-fixing Andean alder *Alnus acuminata* in the upper canopy. Once herbicides are suppressed, some weedy herbs colonize the system. However, farmers have learned to value "weeds" such as *Sida acuta* and *Sida rhombifolia*, both of which are readily eaten by cattle.

Barriers to introducing trees

Tropical cattle ranchers will often admit that they have a bias against trees in pasture-lands. Grass monocultures are favoured in Latin America, at least partly for aesthetic reasons. Herbicide manufacturers have helped to strengthen this taste for open pastures, and some research institutions focus on improving "miracle grasses" and promoting the large-scale cultivation of a few species of *Brachiaria*, rather than on developing more complex and natural systems.

A few exotic fast-growing timber trees have proved useful in weakening such barriers. Some early adopters of ISPSs chose to plant familiar species such as *Eucalyptus* species, *Pinus* species, *Acacia mangium*, *Gmelina arborea* and *T. grandis*. However, some native timber trees are gradually emerging as protagonists of ISPSs in different regions.

Successful selection of native species

Introducing new species in ISPSs, as in reforestation, involves risks. Projects may fail because of inappropriate species choice, a consequence of insufficient knowledge about the performance of native trees in different site conditions. Nevertheless, an important pool of knowledge has developed on native trees. More than 130 neotropical species have been screened by various national projects and several have shown good early growth and survival in degraded areas (van Bruegel *et al*., 2011;

F. LIBRE

Crown architecture is an important aspect of tree selection. **Cordia gerascanthus** ***is a native species of global conservation concern with the ideal architecture for ISPSs***

Hall *et al*., 2011; Montagnini and Finney, 2011, and references therein).

A pioneer farmer in the Andean foothills of Meta department in Colombia chose to test the endemic and rare *Mimosa trianae* on his farm, together with *A. mangium*, *G. arborea* and other species. This virtually unknown native tree species outperformed its exotic competitors and has shown impressive growth. Collected by botanists only eight times since 1856, this nitrogen-fixing species will probably become one of the key elements of ISPSs in the Andean foothills, where, paradoxically, cattle-ranching could contribute to saving it from extinction.

Another example is the silvopastoral system based on the managed succession of *Piptocoma discolor* in the Amazon foothills of Caquetá, Colombia. Once herbicides are eliminated as a tool for maintaining pastures in this moist region, this species regenerates vigorously and is browsed by the cattle. It is not only an excellent fodder shrub, it is also a fast-growing timber tree that forms straight poles that are useful for construction. Thus, *P. discolor* provides fodder and timber and has the ideal tree architecture for live fences and silvopastoral systems (Hurtado *et al*., 2011).

Some ISPSs combine two or more native timber tree species. An area of Colombia's dry Caribbean region has some seasonal limitations because of insufficient drainage. One ISPS for dual-purpose cattle combines improved pastures, a middle layer formed by the native tree *Guazuma ulmifolia* planted at high density for direct browsing and managed as a fodder shrub, and a canopy layer that combines strips of the native timber species *Cordia gerascanthus* and *Tabebuia rosea* and the endangered *Pachira quinata* (Galindo *et al*., 2010; Galindo, Galindo and Blanco, 2010; Calle *et al*., 2012).

INCENTIVES FOR THE ADOPTION OF ISPSs

Those who have an interest in implementing ISPSs face two main classes of barrier:

1. *Financial*. The high initial costs of establishing most ISPSs challenge the traditional view of tropical cattle-ranching as a low-investment activity. Even though the investment can be recovered in a relatively short period (3–4 years), most farmers, technicians and banks have not assimilated this relatively new thinking about cattle-ranching.
2. *Knowledge*. The complexity of ISPSs demands specialized knowledge and technical assistance (Calle, 2008; Chará *et al*., 2011).

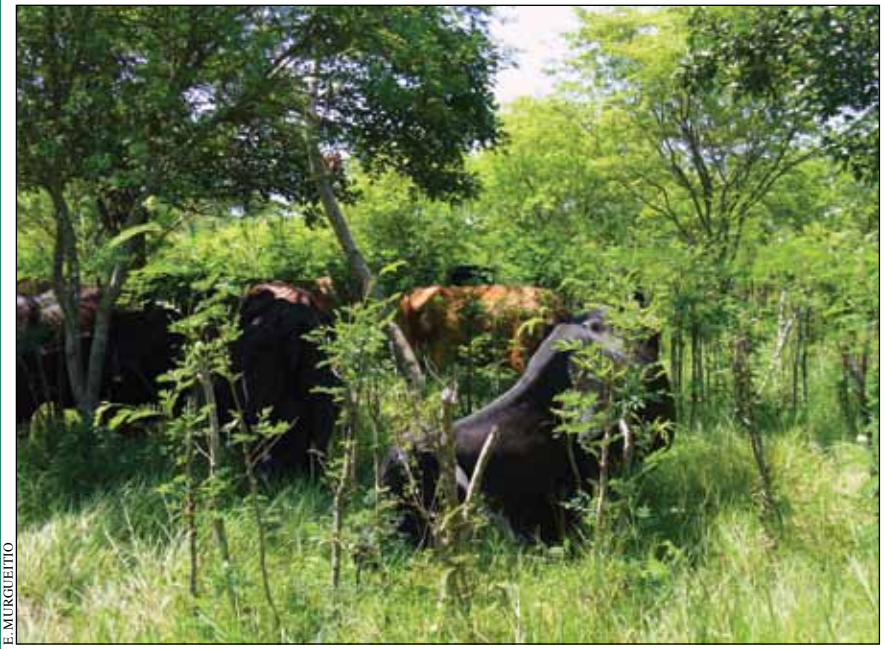
Nevertheless, Latin American cattle-ranchers must quickly adapt to a changing climate and to the challenges of recent free-trade agreements that will demand producing high-quality beef and dairy

Z. CALLE

An important pool of knowledge has been developed on the success rate of native trees in ISPSs. **Mimosa trianae Benth** ***(Fabaceae) is an endemic and virtually "unknown" tree that has outperformed its exotic competitors in silvopastoral systems in the Andean foothills. Andorra farm, Cubarral, Meta, Colombia***

TABLE 1. Types of incentives used to promote the transition of conventional unsustainable practices to silvopastoral systems and other sustainable land uses

Incentive	Socio-economic context and scale of application	Constraints
Donation of trees, supplies and equipment	Small and local groups of farmers	Only multipurpose trees that offer a direct economic benefit without competing with cash crops are attractive to farmers **Risks:** Paternalism, limited adoption and lack of tree care when projects end
Processing of land property documents	All scales (small to large landowners), post-conflict areas and settlements in the agricultural frontier	This incentive should be the final step in closing an agricultural frontier once zero deforestation has been achieved. Certification of a property must be based on clear environmental standards to protect conservation areas **Risks:** Corruption, perverse incentives for deforestation, land concentration and land acquisition by international buyers
Land tax exemption	Fertile lands and high-priced lands near cities and infrastructure such as water-supply systems, dams and roads Local scale (municipality), but often related to a national policy	Up-to-date information on land property must be available. The incentive should be consistent with the opportunity cost of the land; it is insufficiently attractive in areas with profitable and unsustainable activities such as mining and commercial monocultures
Financing of technical assistance (TA) and silvopastoral extension	Necessary at all scales	Requires specialized training for extension workers and technicians The cost of TA must be appropriate for every scale of production. TA should be neither fully subsidized nor very expensive. It demands the permanent availability of financial resources
Credit for establishing ISPSs	Necessary at all scales, but must be adjusted to each group of stakeholders	The main limitations are the lack of access of small farmers to credit, and bureaucratic obstacles. The financial system poses barriers (raising interest rates or requesting more guarantees) A risk of failure exists if the technology is not appropriate for a given ecosystem Credit schemes must be designed so that the flow of payments is synchronized with the biological aspects of the system
Special incentives linked to silvopastoral credit (such as the Rural Capitalization Incentive in Colombia)	National policy with application at all scales	Technological development is needed to ensure the adequate investment of incentives. The technology must be adapted to special conditions such as tropical mountain ecosystems, areas subject to flooding, acid soils and low-fertility areas Limited by available funding. Faces the same limitations as access to credit. Group loans must be developed. National funds to achieve landscape-scale changes are not yet available
Application of forestry incentives to livestock systems (such as the Forestry Incentive Certificate in Colombia)	Should be applicable at all scales but, in practice, incentives are concentrated in high-timber-production areas. Can reach national or regional scales. With further technological development, benefits available for livestock systems could become equivalent to those of forest plantations	More knowledge on native species is required. Technology for the introduction of forest species in ranchlands is nonexistent Development of silvicultural practices, markets and wood-processing techniques for timber produced in silvopastoral systems are insufficient
Payments for ecosystem services	Water may provide opportunities for small landowners in focal watersheds; biodiversity applies at different scales; carbon is attractive mostly to large landowners or large-scale projects Local scale for water, regional scale for carbon and biodiversity. National-scale incentives exist only in specific countries	Requires baseline knowledge and monitoring of the ecosystem service being offered Funding is very limited (i.e. under the United Nations Framework Convention on Climate Change). Most countries have no specific funds and depend on international cooperation Differentiation of short- and long-term payments is very important. Native trees require an additional stimulus
Specialized market incentives (included in the prices paid for products of ISPSs)	Necessary at all scales. Small farmers need access to markets and subsidies throughout the certification process. Larger and entrepreneurial producers need incentives and promotion to enter marketing chains	Requirements include: traceability and certification of milk, meat and wood; certification protocols; impartial certifiers; someone paying for the cost of certification, and a demand for the certified products in specialized markets (biodiversity friendly, carbon neutral, low water footprint or fair trade products) Strong and prolonged campaigns for consumers play an important role in increasing the demand for ISPS products



E. MURGUEITIO

Providing incentives to invest in ISPSs can lead to enhancing productivity of farming systems and the generation of ecosystem goods and services while helping to conserve and restore degraded lands. El Chaco farm, Piedras, Tolima, Colombia

products, at a lower cost and adhering to rigorous environmental standards. Therefore, incentives and financial instruments are needed to promote the large-scale adoption of ISPSs. In the past, private, public and international cooperation programmes have used incentives to promote the adoption of silvopastoral systems and other agroecological practices. The main tools for scaling-up ISPSs are financial incentives, payments for ecosystem services, specialized technical assistance, innovation awards for farmers and market preferences. Table 1 presents incentives that have been used, the scale of their application and their constraints.

The average cost per ha of implementing ISPSs in the dry Caribbean region of Colombia is US$2 500, one-fourth of which (US$625) corresponds to labour (Solarte *et al*., 2011). For the RISAEM project, the average income per ha from cattle-ranching increased from US$237 to US$888 in Colombia, Costa Rica and Nicaragua as a result of the adoption of silvopastoral practices (not exclusively ISPSs) (The World Bank, 2008). On average, conventional pastures provide one rural job per 100 ha, while consolidated ISPSs provide five jobs in the same land area. During the establishment phase, ISPSs can provide as much as one job per 3 ha (Centro para la investigación en sistemas sostenibles de producción agropecuaria [CIPAV], unpublished data). This statistic applies to small-, medium- and large-scale cattle farms, as ISPSs are suitable for all scales, provided that the financial and knowledge barriers can be overcome.

ISPSs can improve the carrying capacity from as few as 0.5 animals per ha to 3 per ha. One ha of ISPS can increase farm income by at least US$440 per ha per year. Therefore, these systems have a substantial potential to contribute to the reduction of rural poverty (CIPAV, unpublished data).

In 2006, dual-purpose farms of the dry Tepalpatepec and Apatzingán valleys in Michoacán, Mexico, began replacing their treeless cattle-ranching systems, which used abundant feed and chemical inputs, with intensive silvopastoral systems. So far, more than 4 000 ha of ISPSs have been established. A recent evaluation of the social and economic impacts of this project revealed that the internal rate of return of such systems increased from 5–11 percent to 33.5 percent when the profitability of milk, meat and leucaena seed was considered. The five-fold increase in farmer income and the doubling of farm expenses have boosted the local economy. Additionally, ISPSs have increased local land value by 33 percent (González-Pérez and Solorio-Sánchez, 2012).

CONCLUSION

In some parts of Latin America, ecological restoration is untenable unless it manifestly bolsters the ecological base for human survival (Society for Ecological Restoration International Science and Policy Working Group, 2004). Restoration must complement and enhance food production (Minnemeyer *et al*., 2011). ISPSs are a good example of a land use that can increase the productivity and profitability of a farming system, enhance the generation of ecosystem goods and services, and facilitate the release of fragile, marginal and strategic areas for strict conservation, all at the same time. However, it will only be possible to scale up these systems in Latin America with national and international support through government policy, market preferences and payments for ecosystem services.

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Finding the money for tropical forest restoration

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The challenge for advocates of forest restoration is to make it financially viable.

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In the past few centuries, many tropical forests have been modified dramatically by human activity, creating landscapes dominated by agriculture or urban development (Bradshaw, Giam and Sodhi, 2010). This is a problem not only because of the loss of biodiversity, but also because it has affected the supply of many valuable forest products and ecosystem services.

Nevertheless, widespread forest loss and degradation has created new opportunities for ecological restoration, which must now go beyond a solely conservation rationale. In human-modified landscapes in developing countries, tropical forest restoration projects must not only assist the recovery of ecosystems that have been degraded, damaged or destroyed (the most used definition of ecological restoration; SER, 2004), they must also bring economic rewards to landowners.

This article discusses the economic dimension of ecological restoration,

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A young tropical forest restoration planting set in pastureland previously used for extensive cattle-ranching in the state of Rio de Janeiro, Brazil. In the future, this project will reconnect isolated remnants of the threatened Atlantic forest and improve the quality of the water supply for the region's growing population

drawing on experiences in the Brazilian Atlantic forest, which is one of the most biodiverse ecosystems on the planet and also one of the richest in endemism (Myers *et al*., 2000).

CREATING SPACE FOR RESTORATION

Globally, the human population is expected to increase by 50 percent over the next four decades. This surge, when combined with a likely per capita increase in consumption, is projected to require the doubling or tripling of food production by 2050 (Godfray *et al*., 2010). The attendant increased need for fuel, fibre and shelter paints a dramatic picture of future land demand (Smith *et al*., 2010).

The looming land crisis has been receiving increasing attention worldwide. In this context, forest restoration could be seen as just another factor in the demand for land, with the potential to reduce food production, increase food prices and have other unwanted consequences. Moreover, where land is scarce, conserving or restoring areas in one region could induce deforestation elsewhere. This effect, known as "leakage", has been considered in international policy, including in negotiations under the United Nations Framework Convention on Climate Change concerning greenhouse gas emissions from deforestation and degradation (Strassburg *et al*., 2009).

Various studies on food production, however, have argued that when land is scarce, the way to balance food production and environmental needs is to improve the use of existing cleared land (Tilman *et al*., 2002; Herrero *et al*., 2010; Phalan *et al*., 2011). Improving the efficiency of pastureland management, in particular, seems to hold promise, especially as the area of these lands worldwide is double that of agricultural lands (Licker *et al*., 2010). Such thinking can also inform the consideration of food production versus forest restoration – because forest restoration can be seen not as a competitor but, rather, as a way of helping to increase food production and improve livelihoods, and as a way of providing landowners with an economic return.

FINDING ECONOMIC BENEFITS

Only 12 percent of the Brazilian Atlantic forest estate remains, concentrated mostly on the coast (Ribeiro *et al*., 2009). The region that hosts this forest accounts for 62 percent of the Brazilian population and 80 percent of its gross domestic product; the environmental pressures, therefore, are very strong (IBGE, 2012).

Centuries of deforestation and forest degradation have compromised the delivery of ecosystem services and the production of forest goods in the Atlantic forest. Nevertheless, the region presents a huge opportunity for new approaches to ecological restoration and for establishing forest restoration as an economically viable practice (Joly *et al*., 2010). The potential for improving the productivity of pasturelands seems to indicate that a large-scale restoration initiative, such as that proposed by the Atlantic Forest Restoration Pact, can be implemented without adversely affecting food production. Launched by over 80 environmental organizations, private companies, governments, researchers and landowners in 2009 (and today boasting 215 partners), the Atlantic Forest Restoration Pact aims to restore 15 million hectares (ha) of forest by 2050 using native species.

The 30.5 million ha of planted pastureland in the Atlantic forest region (PROBIO, 2009) currently support 36 million head of cattle (IBGE, 2003), a stocking rate of 0.82 head per ha. This is very low by international standards and when compared with similar environments elsewhere when appropriate technology is used (FAO, 2012). Doubling the productivity of these lands over the next three decades (such as through innovative silvopastoral approaches; see Calle, Murgueitio and Chará, 2012) would liberate 15.3 million ha for forest restoration – an area equivalent to the restoration goal of the Pact. In addition, restored tropical forests can

The timber harvested in restoration plantings has the potential to cover the opportunity cost of reducing the availability of land for cattle-ranching. This 3-year-old restoration planting, in Campinas, São Paulo, southeastern Brazil, is designed to produce native timber in a 10-year harvesting cycle. It has been shown that this is likely to generate greater returns for farmers than extensive cattle-ranching

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The temporary use of fast-growing eucalypt species as "economic pioneers" can accelerate the economic return of restoration plantings and help offset the establishment and early tending costs of the restoration, which are usually high. This 1-year-old plantation of native tree species in alternate planting lines with eucalyptus in south Bahia is designed to be exploited six years after planting, when all eucalyptus trees are harvested and substituted by native species

potentially help increase crop productivity, since they harbour crop pollinators and natural enemies of pests. If complementary activities are implemented to increase the productivity of lands currently under agriculture and to favour the conversion of unproductive pasturelands to agricultural uses, as already done in some parts of the Brazilian Amazon (Macedo *et al*., 2012), tropical forest restoration could be supported without risking perverse outcomes for food production. These measures would also help to reduce (or prevent the increase of) the opportunity costs of land, an important barrier to forest restoration efforts. The next sections explore some avenues for making forest restoration pay.

Timber

The Atlantic forest has been exploited to the point where it no longer supplies significant quantities of timber. This reduced supply, combined with increasing demand for native timbers, is pushing prices up.

In effect, therefore, overexploitation has created economically favourable conditions for the production of timber from native species through restoration. Another economic advantage of restoration using native species is that it does not require flat terrain or highly fertile soil and can therefore be done on lands that are marginal for many other land uses.

Restoration plantings serve other purposes as well. Most tree species native to the region have not been domesticated, and they have natural pests that may hamper timber production in low-diversity systems (Rodrigues *et al*., 2009). Using a diverse range of tree species decreases the risk of devastating pest attack, thus aligning economic and ecological interests in restoration efforts at scale.

Ecological restoration can be implemented in extensive, low-productivity pasturelands, a main land use in many developing countries. For example, about 75 percent (211 million ha) of all cleared lands in Brazil have been used for extensive cattle-ranching (Sparovek *et al*., 2010). Since the average return obtained by cattle ranchers in those areas is approximately US$100 per ha per year, the production of native timber in restoration plantings could potentially cover the opportunity costs of reducing the availability of land for livestock.

This hypothesis was tested in a recent study in the Brazilian Atlantic forest. Fasiaben (2010) investigated the potential economic return of a 250 ha restoration planting designed for future native timber production. The results were encouraging: the return was estimated at US$250 per ha per year on the basis of very conservative estimates of both timber prices and tree growth and no value adding to the timber. The Atlantic Forest Restoration Pact has elected to use this type of reforestation for restoring about 7 million ha of degraded pastures on sloping land (Calmon *et al*., 2011).

Timber plantations could play a critical role in scaling up restoration efforts in human-dominated tropical landscapes worldwide (Lamb, 1998). However, an important limitation to the production of native timber in restoration plantings is the time required for an economic return. Agriculture has the advantage of generating ongoing income, with much shorter time horizons between investment and return, while timber production can sometimes take decades to become profitable. Three approaches can be used to address this limitation:

- mixed plantings – i.e. planting a mix of slow-growing and fast-growing species, to allow timber production to begin within about ten years of planting;
- combining various sources of income, such as non-wood forest products (NWFPs) and payments for ecosystem services, to generate regular income for landowners (see the following two sections);
- providing long-term credit at attractive rates.

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The production of native seeds, shown here in Ribeirão Grande, São Paulo, southeastern Brazil, to meet the demand of nurseries, could be one of the best NWFP-related avenues for generating income and jobs in local communities through forest restoration

Non-wood forest products

Tropical forests provide a huge range of NWFPs – such as foods, medicines and building materials – the harvest and processing of which often constitute a major source of income and livelihoods for local people, especially in developing countries such as Brazil (Wunder, 1998). To a certain extent, restoration efforts self-generate NWFP-related work for local communities: as such efforts expand they increase the demand for native seeds, which can then be harvested from previously restored areas. Thus, demand for native seeds increases, seed collection and sales increase, and economic opportunities follow (Brancalion *et al*., 2011).

Traditionally, most NWFP harvesting in Brazil occurs in remnants of native forest, but when demand outstrips supply, efforts are needed to cultivate species of interest. There are several examples of this phenomenon related to Brazilian native species. Brazil once led rubber production, when most latex was harvested from native rubber trees (*Hevea brasiliensis*) in the wild. Brazil's production, however, eventually fell behind that of Malaysia, which started to cultivate rubber trees at a large scale. The case of the Brazil nut tree (*Bertholletia excelsa*), the nut of which is the most economically important NWFP harvested in native forests in the Amazon (Peres *et al*., 2003), is similar. In Brazil, nuts continue to be collected in the wild, but in the Plurinational State of Bolivia, investments have been made in cultivation and processing and that country is now the world's biggest producer and exporter of Brazil nut.

There is little industrial-scale investment in the harvesting and processing of NWFPs from native forests because of, among other things, the irregularity and uncertainty of supply, the variable quality of the products, and problems associated with obtaining licences to exploit wild populations. Hence, there is an enormous potential return from producing NWFPs in restoration projects.

Importantly, NWFPs can be crucial for the profitability of restoration by generating an early and regular income for landowners in the period in which timber plantations are not yet ready for harvesting. The case of the endangered palm *Euterpe edulis* in the Brazilian Atlantic forest illustrates the potential of NWFPs to support the economic sustainability of tropical forest restoration. This species produces edible palm heart (the apical meristem and the developing undifferentiated leaves of the palm stem), an expensive delicacy that is much loved in Brazil and elsewhere. Since the extraction of the palm heart causes the death of the plant, overharvesting has drastically reduced the population of this palm to a point where it is at risk of ecological extinction (Reis *et al*., 2000). Restoration plantings of this palm would not only improve its chance of survival, it could prove very profitable.

Moreover, the fruit pulp of *E. edulis* has been introduced as a southeastern equivalent of the Amazonian *açaí* (*E. oleracea*) – a concentrated lipid- and sugar-rich pulp derived from palm fruit that is used for several purposes (Brancalion *et al*., 2012). The plant's seeds have been sold as a byproduct of pulp production. Combined, the production of fruit pulp and seeds could generate revenue of US$2 000 per ha per year, given 100 productive palms per ha. Agroforestry cooperatives have begun to invest in the cultivation of this species and in the commercialization of fruit pulp. In the future, companies that make food, cosmetics, medicines and other products based on NWFPs could create

commercial partnerships with farmers' cooperatives to produce such NWFPs in their restoration areas.

Crop production in agrosuccessional restoration schemes

One of the main challenges in restoration plantings in the tropics is the effective control of invasive fodder grasses, which can dramatically reduce tree growth (Campoe, Stape and Mendes, 2010). Since native trees usually take at least three years to completely shade the understorey and outcompete weeds, considerable resources in restoration projects are usually expended on weed control. While the high incidence of light in the initial phases of restoration plantings creates this problem, it also allows the cultivation of agricultural crops between planting lines – a forestry system known as taungya. Then, instead of spending money on herbicides or mechanical weeding, it is possible to earn money early in a restoration project by producing annual crops such as beans, corn, cassava and pumpkin. This is important for reconciling farmers' interests with ecological restoration, especially on small landholdings in poor regions. As suggested by Vieira, Holl and Peneireiro (2009), agrosuccessional restoration may help in "extending the management period of restoration, offsetting some management costs, providing food security for small landholders, and involving small landholders in the restoration process". Therefore, it is another potential source of revenue that can help make tropical forest restoration a profitable land use.

Ecosystem services

There are many examples worldwide of individual and collective, and public and private, initiatives for the maintenance or recovery of ecosystem services – such as those related to water, biodiversity, carbon and pollination – in degraded areas (Stanton *et al*., 2010). Payments made to landowners for such services by, for example, promoting forest restoration on their degraded lands, are collectively called payments for ecosystem services (PES).

In many developing countries, water-related PES projects are growing in number and area, particularly around large urban areas (FAO, 2010). Water companies and end-users interested in improving the water supply or ensuring water security are creating programmes to pay landowners to restore their riparian areas.

In Brazil, PES is also used by watershed committees, which are collectives responsible for the management of water resources within specific watersheds. Established by Brazilian law, watershed committees charge for the use of water within a watershed and return part of this fee through PES to landowners who implement forest restoration projects (Veiga and Gavaldão, 2011). In Extrema, Minas Gerais, in southeastern Brazil, for example, the municipal government pays approximately US$118 per ha per year to more than 100 landowners with low-productivity pastures who have replaced

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The cultivation of cassava among naturally regenerating and planted trees in a restoration project in the Atlantic forest, northeastern Brazil. In such an arrangement, farmers control weeds to obtain a higher crop yield and indirectly favour the development of native tree species by reducing competition. Project revenue is increased by the production of crops and the reduction of maintenance costs

cattle-ranching with forest restoration plantings on riverbanks and around natural springs. Extrema is within the Cantareira, a water-supply system comprising several reservoirs that together provide water to about 10 million people in the São Paulo metropolitan area. The local government and farmers enter into 4-year contracts, which may be renewed in perpetuity. Since the programme covers all the cost of forest restoration, the payments serve as compensation for the revenue that farmers would have earned if the area had been kept as pastureland (i.e. the opportunity cost).

Forest restoration projects can also generate carbon credits, which can be negotiated either through the compliance market, in accordance with obligations laid out in the Kyoto Protocol, or through the voluntary market, which permits the purchase of carbon offsets to mitigate greenhouse gas emissions. The voluntary market for forest carbon is worth millions of dollars per year (Stanton *et al*., 2010) and continues to expand, in part because there is a growing number of companies interested in offsetting their greenhouse gas emissions and in part because the financial return can be attractive to landowners. On average, mixed plantations of native trees in the Atlantic forest accumulate 15 tonnes of carbon dioxide (CO_2) equivalent per ha per year (Miranda, 2008) and therefore about 450 tonnes of CO_2 equivalent per ha over 30 years (which is the usual duration of a contract for carbon credits). After accounting for greenhouse gases emitted during planting and management, as well as during timber harvesting and processing (as further proposed in our model), such plantations would remove about 300 tonnes of CO_2 equivalent per ha over the period.

The price of carbon credits in reforestation projects is highly variable. In 2011, Latin American credits were negotiated in the voluntary market at an average price of US$11 per CO_2 equivalent tonne (Peters-Stanley and Hamilton, 2012). A contract on these terms would be worth US$3 300 per hectare over the 30-year period (a mean annual revenue of US$110). Such an amount would cover all the costs involved in assisted natural regeneration forest restoration projects, but perhaps not all the costs of restoration projects involving tree-planting. Importantly, payments for carbon credits received in the first few years of a forest restoration project would help to compensate landowners for the lack of income from timber, NWFPs and (previously) ranching or agriculture.

One limitation to earning carbon credits from reforestation with native trees is that the cost of the certification and validation processes is high – and it is tempting to use fast-growing (perhaps non-native) species. Strategies and public policies that aggregate landowners are needed to reduce the cost to individuals.

PES schemes can generate synergies (Strassburg *et al*., 2010): those that target one ecosystem service can usually help in obtaining payments for others (Strassburg *et al*., 2012). Bundling several PES schemes can increase the magnitude and diversity of the income generated by forest restoration.

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In Extrema, Minas Gerais, Brazil, landowners are receiving US$118 per ha per year to allow the restoration of riparian areas important for water production, such as this 1-year-old high-diversity restoration planting

TABLE 1. Opportunity cost and potential revenue, forest restoration in the Atlantic forest region

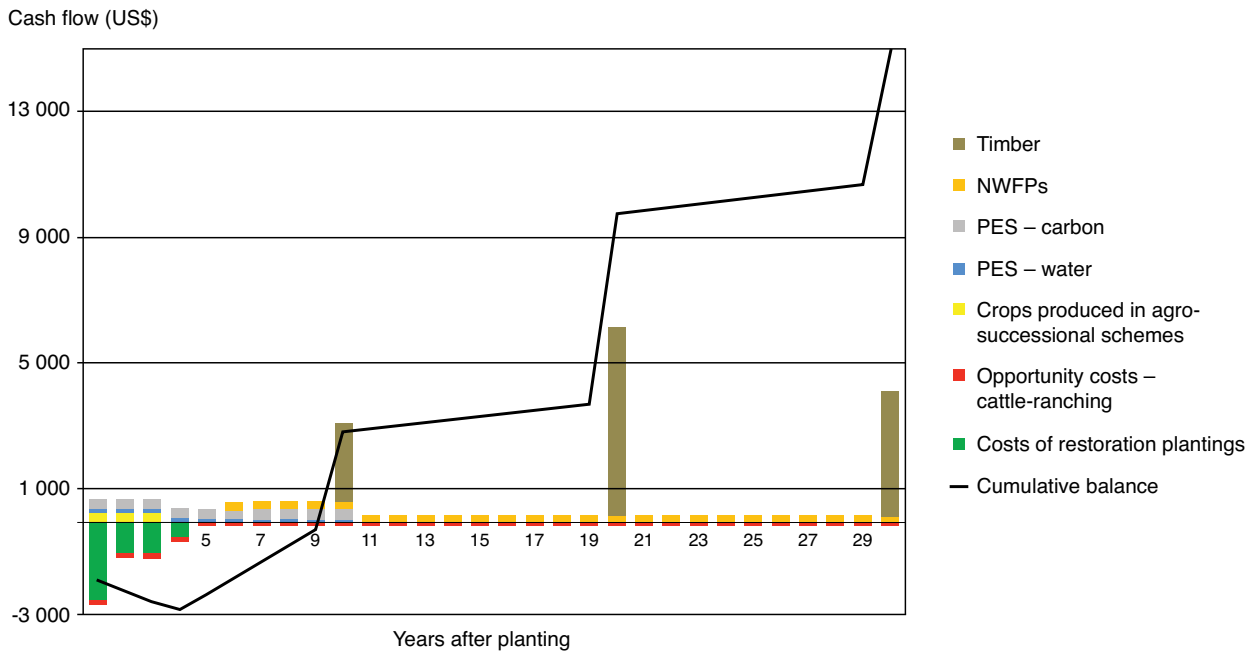
Opportunity cost and potential revenue, forest restoration in the Atlantic forest region	Potential annual revenue[a] (US$/ha/year)	Timeline (years) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	Total accumulated revenue (US$/ha)
Opportunity cost of land for cattle-ranching[b]	-100		-3 000
Income opportunities through restoration			
Crops produced in agrosuccessional schemes[c]	300		900
Payments for ecosystem services – water[d]	118		1 180
Payments for ecosystem services – carbon[e]	330		3 300
NWFPs[f]	200		5 000
Timber – fast-grown species[g]	2 500		2 500
Timber – moderately fast-grown species[g]	4 000		4 000
Timber – slow-grown species[g]	6 000		6 000
Net revenue			**19 880**

a For activities providing annual income, annual value represents the average income obtained during the period proposed for the activity. In the case of timber, annual revenue is restricted to the year of harvesting (i.e. 10, 20 and 30 years for fast-grown, moderately fast-grown and slow-growing species, respectively).
b Of the costs, only opportunity costs are included in this table, since the cost of restoration is met by the Atlantic Forest Restoration Pact.
c Based on the income provided by annual crops traditionally planted in small landholdings, such as beans, corn, cassava and pumpkin. We believe that these crops can be cultivated between tree-planting lines for a period of three years, after which shading may hamper commercial production.
d Based on the model programme of Extrema, Minas Gerais, southeastern Brazil (Veiga and Gavaldão, 2011). Although such payments may last indefinitely, we restrict them here to a period of ten years.
e Based on a net accumulation of 300 tonnes of CO_2 equivalent per ha in 30 years and an average price of US$11 per tonne. The total value to be paid in the 30-year period is concentrated in the first ten years.
f We consider this to be a conservative estimate.
g These values are based on an economic evaluation carried out by Fasiaben (2010) in the Brazilian Atlantic forest and are conservative estimates of both timber prices and tree growth, and do not consider any type of value-adding.

Note: Values are based on overall values estimated for the Brazilian Atlantic forest and are indicative only. They may vary considerably according to species, system of production, the response of the plants to specific site conditions, and the socio-economic context of the project.

Integrating sources of income

The diversification of income sources helps to reduce risk, a very important decision factor for landowners. Therefore, a key challenge is to create conditions that will bring together the various income-generating opportunities in such a way that restoration projects produce crops, wood and non-wood products and one or more ecosystem service. A conceptual framework for merging these opportunities could be a concentration on PES over the first ten years, followed by the exploitation of NWFPs and possibly fast-grown timber species in a second phase, after which the harvesting of higher-value timber could begin, 20 years or so after initial planting. Using the framework and values proposed in Table 1, and reforestation as the main restoration method, the combination of three or more of the seven proposed income opportunities could easily exceed the baseline cost of US$8 000, which includes the opportunity cost of removing cattle-ranching (US$100 per ha per year for 30 years) and the cost of the restoration effort (estimated at US$5 000 per ha). Ten years after the commencement of the project, tropical forest restoration could become more profitable than the current land use of extensive cattle-ranching (Figure 1).



Note: Values are illustrative only and may vary considerably according to species, the system of production, the response of the plants to specific site conditions, and the socio-economic context of the project.

1
Indicative cash flow for various activities proposed for tropical forest restoration in the Brazilian Atlantic forest

THE WAY FORWARD

Historically, forest degradation has been driven by economic forces such as land speculation, easy profits from predatory timber exploitation and the liquidation of natural capital, the expansion of agricultural lands, cities and mining, and road construction. In most cases, societies have supported these activities by demanding and paying for the agricultural products generated at the expense of forests, and it has financed them through public and private loans.

It stands to reason that if a society collectively decides that it wishes to reverse forest degradation and deforestation, and to mitigate the enormous environmental debt bestowed on future generations, the same economic forces must become allies. Following the economic model of supply and demand, the degradation of forest lands reduces natural capital, which consequently increases the demand for forest goods and ecosystem services. To meet this growing demand, supply must be increased: thus, suitable conditions are created for large-scale forest restoration. The various opportunities to transform marginal lands into sustainably managed forests that are economically viable and not in competition with land for food production are, in effect, income opportunities for entrepreneurs who wish to profit from supplying the multiple products and services provided by restored forests.

In order to create this kind of scenario for ecological restoration, it is necessary to:

- strengthen environmental legislation, taking care to avoid obstacles to the cultivation and subsequent use of native species;
- stimulate the consumption of products originating from the sustainable management of native species in restoration projects;
- create attractive loans and credit lines for entrepreneurs interested in forest restoration, while creating obstacles for activities that cause forest degradation;
- invest in applied research on the cultivation, genetic improvement and processing of native species;
- reinforce the ability of outreach agencies to transfer technology and know-how to farmers;
- build public policies to implement and support these measures.

If economic forces are not incorporated into the design and implementation of restoration projects, forest-restoration advocates are likely to continue practising a kind of "environmental gardening" – projects that are small in scale, have low cost-effectiveness, are not integrated at the landscape level and have negligible participation from landowners and society in general and little impact on degradation. Upscaling tropical forest restoration is urgent and necessary – and eminently economically viable. ◆

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The role of community forest management in REDD+

M. Skutsch and M.K. McCall

There is great potential for community-based REDD+ approaches in dry tropical forests.

REDD+ is the term used for a proposed multilateral policy aiming to incentivize developing countries to reduce greenhouse gas emissions and increase removals by limiting deforestation and forest degradation, conserving forest carbon stocks, sustainably managing forests and enhancing forest carbon stocks. It is being developed within the United Nations Framework Convention on Climate Change (UNFCCC) with the aim of providing developing countries with financial incentives to take action to mitigate climate change. In the so-called full implementation phase it may enable polluters to pay for their emissions offsets.

M. SKUTSCH

Where will REDD+ lead? Foresters and community members map a community forest boundary with a mobile geographic information system, United Republic of Tanzania

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REDD+ is intended to be implemented as a national and results-based policy, in which payments would be related to actual carbon emissions reductions and paid in proportion to these at the end of an accounting period (the length of which is yet to be determined). Performance is to be measured taking into account the country's entire forest estate, in part to deal with internal leakage.[1] The reduction of emissions should be measured against a reference level representing the estimated level of emissions that would have occurred without the REDD+ intervention. It is not yet clear whether REDD+ payments for carbon will be provided through a market structure (with credits, as is done in the Clean Development Mechanism) or via a global fund, or through a combination of different financial instruments. The failure of the Conference of the Parties to the UNFCCC to agree on binding emissions reduction targets for industrialized countries, and the character of some activities (e.g. conservation), makes the use of market instruments – seen by some observers as the most efficient and effective approach – less likely to be the only instruments used, at least in the short term. Agrawal, Nepstad and Chhatre (2011) provide a good overview of the current state of negotiations on REDD+ and the issues under debate.

NATIONAL VERSUS PROJECT APPROACH

One reason why parties to the UNFCCC have favoured a national-level rather than a project approach to REDD+ is that it is evident that it will require national policies and measures that go far beyond the forest sector, since many of the drivers of deforestation and forest degradation are rooted in the wider economy. Globally, the strongest driver of deforestation is the expansion of large-scale agriculture and cattle-ranching; to be effective, therefore, most national REDD+ strategies will need to find ways to reduce such cross-sectoral drivers. Logging – legal or illegal – can be a contributing factor to deforestation if conducted unsustainably, and bringing about sustainable forest management requires the political will to strengthen forest laws and improve the ways in which they are enforced.

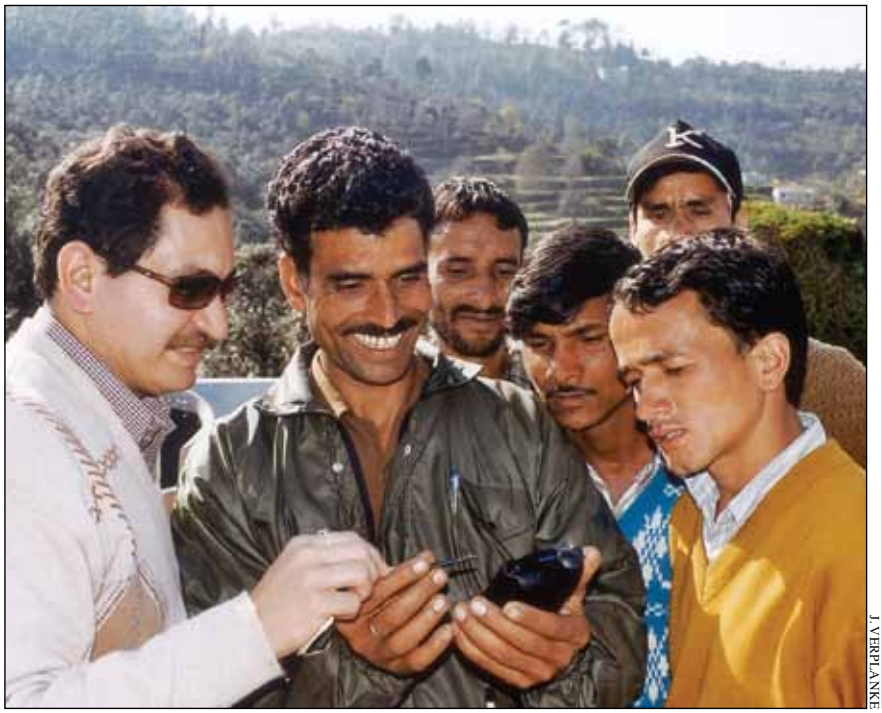
AN INSTRUMENT FOR COMMUNITIES?

Much of the literature sees REDD+ as an instrument directed at communities and other small-scale forest owners and managers, based on the idea of payments for ecosystem services (PES) and the experience of many small-scale forest carbon projects in the voluntary sector, such as those in Central America, for example Costa Rica (Kaimowitz, 2008; Agrawal and Angelsen, 2009; Engel, Wünscher and Wunder, 2009). Significantly, all 26 (as of May 2012) of the REDD+ readiness proposals presented to the World Bank's Forest Carbon Partnership Facility (FCPF), and most of those in the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD), make reference to community forest management – even for countries like Argentina, where very little forest is in community hands. In some countries (e.g. Ethiopia, Madagascar, Nepal, the United Republic of Tanzania and many Andean and Central American countries), a nationally organized community management programme is central to the proposed national REDD+ approach, although how (and especially to whom) payments will be made is usually not specified.

Who will capture the benefits?

There is a danger that a national-level approach to REDD+ could reverse the gains that have been made in the last 20 years in the decentralization of forest management and the recognition of

In some countries there is concern that local communities will not receive economic rewards from REDD+, particularly where tenure is informal. Mapping and recording carbon stock growth may strengthen community claims



I. VERPLANKE

[1] Leakage occurs when emissions in one location are displaced to another as a result of intervention in the first location. In a national approach to REDD+, leakage within the country would not be an issue, because changes in emissions are aggregated at the national level.

TABLE 1. Estimated current contribution of community forest management to reducing greenhouse gas emissions due to deforestation and forest degradation and by enhancing carbon stocks, by type of community forestry or governance regime

Type of community forestry/governance regime	Typical area of forest under management: total/per household	Current estimated contribution to:			Notes
		reducing emissions from deforestation	reducing emissions from forest degradation	enhancement of forest carbon stock	
Community-based, collaborative and participatory forest management on state land; management plans ensure that the extraction of forest products is within sustainable limits in return for community rights to these products (e.g. Indonesia/Kenya/Nepal/United Republic of Tanzania/Viet Nam models)	50–500 ha/ 1–5 ha	Medium/ low	High to very high	High	Highly dependent on administration and allocation of rights to communities
Community management on land owned by communities, incentivized by subsidies from government for improved management and conservation; may involve sustainable extraction of wood and non-wood products, and conservation (e.g. PES model, Mexico/Costa Rica model)	50–500 ha/ 1–5 ha	Medium	High	Medium to high	Highly dependent on funding (PES) for sustainability
Indigenous peoples' reserves, typically involving large forest areas and low population densities, where rights to ancestral lands are formally recognized, deterring incursions by external loggers, etc. (e.g. Amazon model)	5 000– 50 000 ha/ 50–500 ha	High	Medium to high	Low	Needs strong support from government to overcome external pressures for resources

Source: Adapted from FCPF (2011).

community rights over forest products (Phelps, Webb and Agrawal, 2010). Doubts have been expressed about the effectiveness of REDD+ given the political and economic pressures involved and the poor track record that many countries have in forest governance (e.g. Corbera, Estrada and Brown, 2010). Concern has also been raised – particularly by non-governmental organizations (NGOs) and in the bilateral donor sector – about whether local communities will receive any economic rewards from REDD+, especially where tenure is informal (e.g. Dooley *et al*., 2008; Naughton-Treves and Day, 2012). In areas where the forest is formally owned by government, the risk arises that people who currently exercise customary rights may be alienated from the forest on the grounds that they are responsible for the degradation, and that even if they engage in activities which ensure the sustainability of carbon stocks, they may not be entitled to the financial benefits. Even in countries like Mexico, where most of the forest is legally held by agrarian communities, it is not clear what rights such communities may have over carbon (Robles, 2011). Women may be especially disadvantaged because in many societies they face tenure restrictions on land and forest resources (Setyowati, 2012). It is certainly possible that governments could capture all or most of the financial benefits, leaving very little to trickle down to the communities and small landowners who are practising the actual forest management.

Several NGOs have campaigned to ensure that the benefits of REDD+ reach local communities, although so far few have pursued the issue of direct ownership of carbon (Peskett and Brodnig, 2011; Costenbader, 2009). There has also been a movement towards what is called nested REDD+, which has been interpreted by some as a system in which credits would be allocated directly by the state to forest owners or managers at the local level and could then be sold or exchanged by them in the international market (Cortez *et al*., 2010). Most proponents acknowledge, however, that these credits would have to be reconciled with accounts at the national level and deducted from total national credits through jurisdictional accounting (Chargas *et al*., 2011). In practice this approach could create considerable difficulties, since under the UNFCCC such local carbon credits would only be available for sale to the extent that the country as a whole has reduced forest-related greenhouse gas emissions. Thus, overall, there is still much uncertainty as to how rewards for community forest management will fit within national REDD+ programmes.

WHAT CAN COMMUNITY FOREST MANAGEMENT ACHIEVE?

In resolving the issues identified above it is necessary to take a hard look at what community forest management can realistically achieve under REDD+. At an international workshop hosted by the FCPF on the role of community monitoring in REDD+ (FCPF, 2011), participants from 15 countries with many years of experience in community forestry carried out an exercise to estimate the extent to which different forms of community forest management are contributing to reducing deforestation and degradation and to the enhancement of carbon stocks.

The results of the exercise are summarized in Table 1, which distinguishes between active community management, usually on state-owned land (as, for example, in community-based forest management and joint forest management programmes), community management on a community's own land through PES, and large-scale community reserves designated primarily for conservation. The table shows that the first two forms of community management tend to reduce forest

Participatory mapping by the Cuzalapa Women's Group, Mexico. Including community mapping and monitoring as a management activity could be an important stimulus for REDD+

M. MCCALL

degradation through the improved management of the extraction process; they also often result in increases in carbon stocks but are less effective in reducing deforestation. The reason for this is that a great deal of degradation is a direct result of local subsistence use of wood and non-wood resources when extraction is unsustainably high.[2] Reducing such degradation is likely to have relatively low opportunity costs and the success of community forest management programmes in countries such as Mexico, Nepal and the United Republic of Tanzania demonstrate that those costs are not prohibitive under a well-functioning communal regime.

It is doubtful, however, that community management is a bulwark against deforestation, which to a large extent is driven by outside economic forces and for which the opportunity costs may be much higher. Community forest management regimes may be unable to withstand the market forces exerted when much higher rents can be earned by converting to, or selling forest for, other land uses such as logging, cattle-ranching, plantations and urban development. Moreover, these market incentives may often be reinforced by external political pressures or simply by brute force. Large-scale indigenous peoples' reserves such as those in the Amazon, on the other hand, are usually not subject to significant locally caused degradation, given the nature of livelihood strategies and very low population densities in many such areas. Formalizing and publicizing a community's ownership of its ancestral lands strengthens its rights over the forest and should help to discourage outside agents from attempting to deforest or to harvest the forest for their own benefit.

A NICHE FOR COMMUNITY FOREST MANAGEMENT

Strikingly, national plans for REDD+ have not clearly distinguished between deforestation, forest degradation and forest enhancement. Degradation is often implicitly understood to be just a step on the way to full deforestation, but this does not always reflect reality because degradation and deforestation are in most cases the result of different processes. Where degradation has been addressed in the REDD+ literature as an independent phenomenon, this has mostly been in the context of selective logging in rainforests, such as in Amazonia (e.g. Souza, Roberts and Cochrane, 2005; Asner *et al*., 2005). It has not been in the broader context of the small but persistent pressures exerted on forests by local communities, which are both widespread – particularly in the more densely populated dry tropical forests and savannahs — and growing, in line with high local population growth.

Reducing degradation and stimulating stock enhancement in community forests

The most effective sites for community forest management in REDD+ may well be in moderately to heavily populated areas – especially in the broad belts of

[2] In addition to the overharvesting of timber, poles, woodfuel and non-wood forest products, degradation can be caused by the grazing of privately owned animals in communal forests, escaped fire from agriculture, and charcoal production.

tropical dry forest and savannahs – where forest degradation is primarily the result of inefficient use by local communities. For example, community forest management in savannah woodlands in East and West Africa has been shown to achieve sequestration of 1–20 tonnes of carbon dioxide per hectare per year, in addition to reductions in emissions from degradation, which may be in the order of 2 tonnes per hectare per year (Skutsch and Solis, 2011; Skutsch and Ba, 2009).

It is not that the final consumption of the forest products needs to be, or can be, decreased – these are an essential part of the livelihoods of many communities – but that significant improvements in forest-based carbon storage can be achieved by improving the overall management of the forest. Communities can be encouraged to adopt more sustainable harvesting practices to reduce degradation, with either direct carbon payments within REDD+ or other incentives. The latter need not be financial and could include more secure legal recognition of land rights, guaranteed rights to an agreed level of harvesting, the protection of cultural areas, technological improvements, and support in finding new products or markets for wood and non-wood forest products (Hecht, 2009).

Any scheme for payments to a community for carbon is likely to have more impact and be more acceptable where complementary PES programmes are operating in the same community, for example in Mexico (Larrazabal *et al*., 2012; Benneker and McCall, 2009). The returns from carbon payments are expected to be low, but where the payments are adding to existing PES programmes, for example biodiversity conservation or hydrological or pollination services, the overall financial benefits for the community of improved management may be sufficient to support improved forest management. In many cases, such an approach will not only reduce degradation, it will reverse it, leading to increases in carbon stock ("enhancement") over time.

Including community mapping and monitoring as a management activity may be an important stimulus for REDD+ (McCall, 2011; Knowles *et al*., 2010; Coleman and Steed, 2009). It has been shown that communities are able to measure carbon stock increases and monitor other environmental variables with considerable accuracy and at low cost (Larrazabal *et al*., 2012; Danielsen *et al*., 2010; Skutsch *et al*., 2009). Significantly, at least 10 of the 26 REDD readiness proposals at the FCPF specifically mention community monitoring as part of community approaches to REDD+.

Deforestation has to be tackled at a much higher level, using economic and political instruments to influence the direct (usually non-community) agents and indirect drivers. Deforestation should be distinguished clearly in national strategies from community-level efforts to reduce degradation. Dividing national policy in this way could also result in a more transparent and equitable system for allocating carbon credits, in which achievements in reducing deforestation would be attributed to government at the national or state level and reductions in degradation and increases in carbon stock in specific forest areas would be attributed to local actors (Balderas and Skutsch, 2012).

Community conservation

Communities might be involved in reducing deforestation through, for example, the creation of large-scale community-owned reserves in areas where there is low population density. In such cases, the primary REDD+ approach would be conservation rather than sustainable use, and the major political instrument would be the formalization of indigenous or other traditional rights to land. There is always the danger that a reduction in deforestation in such reserves would simply be offset by an increase elsewhere (i.e. leakage). Thus, such approaches to forest carbon conservation can only ever be part of a more comprehensive approach to reducing deforestation and forest degradation, which has to face up to the twin drivers of unsustainable over-consumption and human demographics (Skutsch and McCall, 2010).

CONCLUSION

In sum, community forest management can play a major role in REDD+, especially when programmes for its stimulation are focused in areas where it can be most effective. We suggest that community forest management may be more effective in addressing emissions from forest degradation than from deforestation, and that it may be particularly efficient in dry tropical forests and savannahs, where generally population densities are much higher and the use of tree resources more widespread than in rainforests. ◆

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Ensuring that women benefit from REDD+

A. Setyowati

There is a risk that this sustainable development mechanism will ignore half the population.

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This article was adapted from a WOCAN Policy Brief on gender and REDD+.

Women contribute significantly to forest management; for example, they practise traditional agroforestry and gather fuelwood and non-wood forest products (NWFPs) for food, medicine and fodder. In some countries, such as Indonesia and Viet Nam, women engage in nursery activities and patrol and monitor forests.

Given their involvement in forest management, women should be among the beneficiaries of forest-related sustainable development initiatives. One way in which forest ecosystem services can be monetized is through REDD+, which is a mechanism to encourage developing countries to contribute to climate change mitigation in the forest sector through the following activities: reducing emissions from deforestation and forest degradation; the conservation of forest carbon stocks; the sustainable management of forests; and the enhancement of

Women wash clothes and bath in a forest river in Thailand. Effective REDD+ policies will recognize that women have an intimate engagement with forests and incorporate their perspectives

FAO/FO-5994/G. SHUTAOOM

forest carbon stocks (CPF, 2012). It has the potential to create a financial value for the carbon stored in forests and therefore an incentive to reduce emissions from forests and to invest in low-carbon sustainable development pathways.

There is considerable debate on how to ensure that forest communities – not only national governments and local elites – benefit from REDD+ payments. Although women represent 70 percent of the poor worldwide (UNDP, 1995), however, it seems that the international community, governments and project implementers have neither seriously considered the gender-differentiated implications of REDD+ nor taken measures to address them.

The REDD+ mechanism poses several potential risks for women, which, if not considered as a matter of urgency, could underline or broaden gender disparity. Women are likely to be affected by REDD+ policies differently to men, possibly to their detriment. For example, they could be subjected to higher workloads without appropriately scaled compensation, displaced from or denied access to forests, denied a fair share of benefits, or left out of consultations and capacity-building activities (Gurung *et al*., 2011).

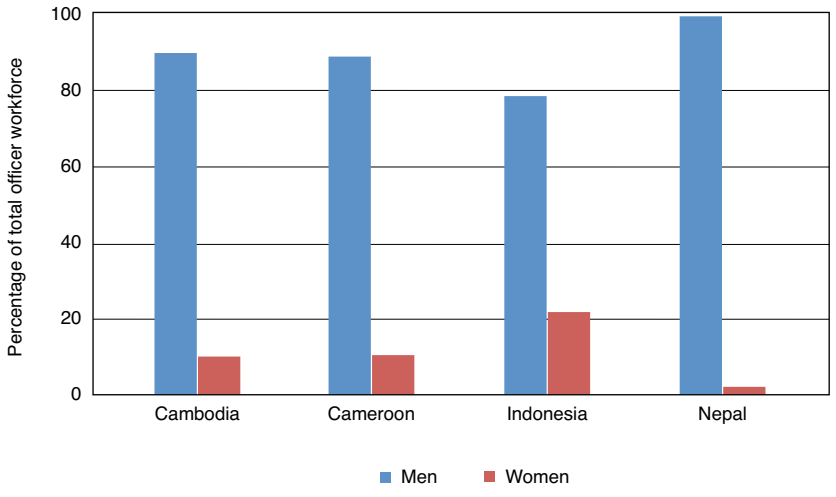
As many countries are developing REDD+ policies that will likely transform the way in which forests are governed, this article considers gender disparity in the forest sector and the ways in which women could be excluded from the benefits of REDD+. It explores how women are critical to the success of REDD+ and describes those aspects most likely to affect women differentially. Finally, it recommends that REDD+ policies incorporate a gender perspective, and that women participate in their development.

WOMEN AND FOREST MANAGEMENT

Given their intimate engagement with forests, women have knowledge, skills and experience that can benefit the implementation of REDD+ policies. Under REDD+, for example, women could play critical roles in forest management and monitoring. Moreover, women's groups can be effective structures for community-based forest management.

However, women are often excluded from forest management decisions because of sociocultural norms and legal impediments that limit their access to forests and decision-making processes. For example:

- Women are rarely recognized as primary stakeholders in forests. Although decisions about forest management affect their lives and livelihoods, women are restricted in their ability to voice concerns and be involved in decision-making. Because they often lack employment and decision-making power within their communities, as well as formal education, women are rarely able to influence the allocation of resources and household decisions.
- A failure to recognize that women and men have differentiated roles, rights, responsibilities and knowledge in forests usually results in inequitable benefit-sharing and a widening of the gap between women and men. Women are often denied access to services, credit, technology and capacity-building activities.
- Women continue to be at a disadvantage because of insecure access and a lack of property rights to forests, trees and other forest resources, under both statutory and customary regimes. Even in countries with laws that provide for women and men to have equal access to land and forests, women might not be aware of their rights. Customs may also exclude women from *de facto* access to and control over forest lands and resources. Women may not have access to other supportive services, such as extension programmes and training, which can influence their long-term commitment to sustainable forest management.
- Women are generally underrepresented in forestry agencies and local forestry institutions (Figure 1), which further limits their opportunities to influence forest-related decisions and to take leadership roles.



Source: Government of Cambodia, 2009; Gurung *et al*., 2011.

1
The gender of officers in forestry agencies in Cambodia, Cameroon, Indonesia and Nepal

FAO/M. MUGISHA

A woman carts firewood in Kapchorwa district, Uganda. The recognition of women's rights of access to forest lands, resources and carbon is essential for successful REDD+

International agreements on gender equity

Engaging women in REDD+ programmes is critical for the achievement of equitable and sustainable results in REDD+. It is also necessary under international agreements on gender equality, in particular the United Nations Convention on the Elimination of All Forms of Discrimination against Women; and the United Nations Economic and Social Council's Resolution 2005/31: Mainstreaming a Gender Perspective into All Policies and Programmes in the United Nations System.

WOMEN AND REDD+

A gender perspective is needed in REDD+ policies to ensure that entrenched barriers to women are recognized, considered and lifted. Without such a perspective, there is a risk that REDD+ policies will perpetuate women's exclusion from decision-making processes. In addition, REDD+ initiatives could reinforce gender inequality and stereotypes by working within existing sociocultural norms and placing a higher value on the work of men.

If properly designed, however, REDD+ could help provide women with new rights to forest lands and resources and increase their capacity to engage in REDD+ decision-making and to improve their economic and social status. With an estimated US$30 billion at stake (Gurung *et al*., 2011), REDD+ could have a significant impact on the empowerment of women and help improve their access to education, health and other public services. But this will require that women are recognized as stakeholders in REDD+ policy-making and more deliberately engaged in the design and implementation of REDD+ policies. REDD+ financing mechanisms would need to secure the right of women to access forest lands and resources, as well as to obtain carbon rights. These issues, as well as the benefit-sharing mechanism, are explored in the next section.

Key issues in gender and REDD+

Participation and representation in decision-making

The formal recognition of women's roles creates an enabling environment and provides opportunities for women to assume leadership roles in REDD+ processes, including decision-making. The effective participation of women requires recognition of their substantive rights (e.g. their right to lands and forests) and procedural rights (e.g. the right to be engaged in consultations).

Although attention to the linkage of gender issues and REDD+ is gradually

FAO/ARMAND ASSENGZÉ

Many girls and women spend significant portions of their time in forests gathering fuelwood and non-wood forest products and are key stakeholders in REDD+. These girls are selling* Gnetum *species, collected in the forest, at a market in Abala, Republic of the Congo

increasing, the representation of women at various levels of consultations on REDD+ policies is still limited, and the role of women in decision-making is still restricted. In addition, and perhaps as a result, many existing REDD+ projects reinforce gender inequality by failing to acknowledge women as equal partners in design, consultation, decision-making and the benefit-sharing mechanism (Gurung *et al*., 2011).

At the local level, the heavy burden of work duties and certain sociocultural factors have kept women politically and culturally marginalized from REDD+ decision-making structures. The REDD+ framework has also become complex and the language highly technical, limiting the effectiveness of efforts aimed at ensuring the participation of women, particularly poor rural women with little, if any, education.

There is an argument that women are part of "communities and indigenous groups" and therefore will be catered for under that umbrella in negotiations on REDD+. This neglects, however, entrenched gender biases, even within such communities and groups. Unless specific provision is made for the participation of women, they simply will not benefit proportionately. REDD+ policies should provide mechanisms that advance women's rights to forest resources and carbon and guarantee equal and appropriate access to revenue from REDD+ initiatives.

Forest tenure and carbon rights

The implementation of REDD+ policies is likely to affect large forest areas on which forest-dependent communities rely. In most developing countries, however, there are rarely clear arrangements regarding forest tenure. Communities' rights are often ill-defined in statutes, and weakly enforced. Because REDD+ can potentially increase the value of forests, establishing rights may face new challenges.

Also at play is the nature of rights to forest carbon. Carbon is a new commodity and, as such, policies on the rights associated with it are either unclear or undeveloped in many countries (Peskett and Brodnig, 2011). According to some, carbon rights should be attached to land ownership (USAID, 2011). Others counter that, since large areas of forest in Africa and Asia are owned by the state but *de facto* are managed by local communities, including women, using land ownership as the sole basis for granting carbon rights is impractical (USAID, 2011).

Clear and secure tenure over forest lands and clarification as to which groups have rights to carbon or to otherwise benefit from it are necessary preconditions for the successful implementation of REDD+, where success is measured by the equitability of the allocation of benefits. Once an equitable tenure regime has been established, it must not be undermined by REDD+. There is a risk that it will be, however: a study in Paraguay showed that rushing the process of designing and implementing a REDD+ programme to meet validation requirements could cause project developers to simplify complex patterns of forest use and marginalize local people, including women, who have traditional usufruct rights (USAID, 2011).

Individuals with tenure and carbon rights are well-placed to participate in

decision-making processes and to benefit from REDD+. Clear and just tenure and carbon rights allow project proponents to devise equal and just benefit-sharing mechanisms, identify incentives to encourage appropriate changes of behaviour, and ensure the long-term security of their project. The recognition of women's rights of access to forest lands, resources and carbon is therefore essential for successful REDD+.

Benefit-sharing mechanisms

The benefit-sharing mechanisms to be used in REDD+ initiatives are critical because they will determine the ways in which financial benefits are allocated among stakeholders. If designed well and implemented carefully, benefit-sharing can be an avenue for participating communities to be empowered economically and politically; for government to gain social inclusiveness and ensure social, economic and environmental balance in all aspects of REDD+ initiatives; and for investors to reduce project risks (Peskett, 2011).

Most REDD+ initiatives are in early stages of development, so few countries and projects have clearly defined their benefit-sharing mechanism. Some countries, such as Brazil, Costa Rica, Indonesia and the United Republic of Tanzania, have developed policies to regulate the distribution of REDD+ benefits, but none of those policies specifically addresses gender issues. In all cases, women have been minimally involved in the decision-making processes to develop the benefit-sharing mechanism.

In most cases, tenure and carbon rights will determine who is eligible for REDD+ benefits. Since women often have weak rights, if any, over forest lands and trees, it is unlikely that REDD+ initiatives will bring benefits to them if the status quo is maintained.

To date, debates among policy-makers about benefit-sharing mechanisms at the international and national levels have included little discussion about how benefits are shared within communities, and how benefit-sharing might have a gendered impact in terms of economic opportunities, empowerment and vulnerability (Gurung and Setyowati, 2012). The underlying assumption is that transferring benefits to community institutions guarantees that payments will be meted out, or will trickle down, appropriately to community members. This assumption neglects the dynamics of power relations embedded in cultural and social structures within communities.

Adding another barrier to women's participation in benefit-sharing mechanisms is that most village-level forest institutions are dominated by men. Even if benefit-sharing mechanisms include a gender perspective, therefore, it is critical that women participate meaningfully in decision-making processes. Otherwise, it will be difficult to ensure that women's interests and needs are considered.

When women have not been included in the benefit-sharing mechanism ...

In Indonesia, projects involving payments for ecosystem services have shown that, when women are not clearly targeted as beneficiaries through such means as including their names in certificates and contracts, it is unlikely that they will obtain project benefits (Leimona and Amanah, 2010). In community forestry projects in India, cash income distributed to community representatives who are mostly men is often spent on activities from which women cannot benefit (Gurung *et al.*, 2011). In a forest carbon project in the Nile Basin, a requirement that community groups include women has induced men to register their wives' names without providing them with access to decision-making processes (Peskett, 2011). Thus, even where a policy mandating the inclusion of women in projects is in place, gender audits are needed to ensure that women receive REDD+ benefits and could meaningfully participate in decision-making processes.

POLICY RECOMMENDATIONS

Gender issues are likely to be addressed most effectively if they are put on the negotiation table discretely. As most international and national policies on REDD+ are still being formed, there remains a great opportunity to address gender perspectives in REDD+. The following will help ensure that the opportunity is grasped:

- *Collect and analyse gender-disaggregated information to inform REDD+ policies*. Data should speak to the use of resources, access to resources and participation in REDD+ decision-making. Quantifying the differentiated needs of women and men is the first step towards developing gender-responsive policies and programmes.
- *Acknowledge women's rights to forest resources and carbon*. Land tenure policies that officially recognize women's rights to forest products and forest carbon are crucial for ensuring that women have an equitable share of the revenue from REDD+ initiatives and that women's traditional access to forests is not restricted.
- *Provide for equal access to benefit-sharing*. Mechanisms for distributing benefits should recognize and equitably and proportionately reward women's and men's contributions to REDD+ activities. A simple instance of such a mechanism would be to state explicitly in project contracts that women are targeted beneficiaries. Gaps and opportunities in current benefit-sharing systems should be analysed and gender equity built into their design. Gender audits should be conducted periodically to ensure that REDD+ revenue is being used as intended and that activities designed to empower women are carried out.
- *Guarantee equal access to decision-making structures*. Women's central role in forest management needs to be recognized and measures developed to increase women's participation in the development and implementation of REDD+ policies. One such measure

Important questions to be considered in developing gender-sensitive REDD+ initiatives

- **Which women's and men's roles affect the use and management of forest resources on a project site? Is there gender differentiation in labour and responsibilities in forest use and related activities?**
- **What gender-related factors determine access to and control over forest resources and REDD+ benefits?**
- **Will the project affect the level of women's engagement in forest-related activities? How?**
- **What constraints – time, financial and social – are there to the participation of women in REDD+ project activities? Do these parameters vary depending on the time of year? What are women's needs to enhance their participation?**
- **Are there harmful cultural practices that might be supported or exacerbated by the project?**
- **What are the practical and strategic needs of women and men affected by the project to mitigate harmful practices and leverage social change?**

would be to mandate a fixed (minimum) percentage of women who must participate in all phases of REDD+ processes. There should also be official channels through which women can have a voice in REDD+ decision-making and support for increasing women's membership in governing bodies for community forestry in local and national administrations, including those that make decisions related to REDD+. A percentage of seats could be set aside for women representatives (30 percent is a common tipping point for such a measure of affirmative action).

- *Build capacity.* Many women will need new skills to participate meaningfully in REDD+ initiatives and decision-making processes, such as literacy and numeracy and skills in public-speaking, advocacy, community-organizing and negotiation. To enable women to make informed decisions, they should also have full access to knowledge and information on REDD+ risks and opportunities and on the responsibilities they will assume should they participate in a scheme. Women's needs vary, so it is crucial both to assess those needs and to allocate sufficient funds to support training. To help overcome social and political obstacles that might prevent women's effective participation in REDD+, training in gender awareness should be provided for both women and men to nurture an environment conducive to joint participation and to build support among men for women in leadership.
- *Promote renewable energy and agroforestry technologies to meet the needs of women for fuelwood and fodder while building resilience to climate change.* In their roles as farmers and food providers, poor women are likely to be affected profoundly by climate change and population growth. Women in smallholder farming communities who rely on forests and have limited ability to expand or intensify their operations will suffer if those resources dwindle. Agroforestry can play an important role in improving the resilience of farming systems to climate variability. As well, it can improve food security and provide fodder for livestock, thus easing women's workloads and helping to alleviate hunger and poverty. ◆

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Sustainable forest irrigation in arid and semi-arid zones

A. Del Lungo

A regional project is testing the use of treated wastewater in forestry and agroforestry systems on marginal lands as a way of turning it into a valuable asset for improving livelihoods and food security.

Highly populated arid and semi-arid countries produce large quantities of wastewater, the management of which is a serious concern. In many countries, untreated wastewater is released onto abandoned land, where it creates health and environmental hazards.

If treated, however, wastewater can be an important resource for agroforestry and forestry, helping to produce wood and fuelwood and create windbreaks and shelterbelts for farmers and smallholders, thereby improving food security (Armitage, 1985; FAO, 1989; Braatz and Kandiah, 1996). New wastewater treatment technologies combined with improved drip irrigation systems offer the potential for considerable afforestation in semi-arid and arid zones, which would help to meet people's needs for forest goods and ecosystem services as well as to restore degraded landscapes, combat desertification and mitigate climate change by sequestering carbon.

FAO Forestry and treated wastewater

In recent years there has been an increase in requests from Mediterranean and Near East countries to involve FAO in the development and implementation of projects to use treated wastewater in forestry and agroforestry systems. FAO and the Italian government have responded to such requests with a project[1] to apply new technologies in the production and management of treated wastewater in four North African countries – Algeria, Egypt, Morocco and Tunisia.

Case studies in the sustainable use of treated wastewater

Phytodepuration

Phytodepuration (sometimes called constructed wetlands) is the use of plants – usually grass reeds and rushes – to filter and purify wastewater; the resulting treated water can be used for the irrigation of trees or fodder crops. Phytodepuration systems are cost-effective, affordable and sustainable, especially in rural communities in remote, dry areas which may be unable to sustain the cost of standard-treatment wastewater plants. The Forestry Department of the University of Tuscia, Italy, is testing a small phytodepuration treatment facility at the Brézina Oasis in Algeria. It will use grass reeds and rushes to purify wastewater, which will then be used to irrigate a small forest plantation for the production of bioenergy.

FAO/A. DEL LUNGO

Local stakeholders review the design of the phytodepuration facility, Brézina Oasis

FAO/A. DEL LUNGO

The phytodepuration facility at the Brézina Oasis, which is being installed with the support of the University of Tuscia

Ferti-irrigation

Treated wastewater can increase carbon storage in the soil. The University of Basilicata, Italy, has developed a system for retaining organic matter in treated wastewater to be used for the ferti-irrigation (that is, simultaneous fertilization and irrigation) of poor soils in arid areas. It has been used for ten years to irrigate an olive grove and has been shown to decrease energy costs, increase olive yield and improve soil fertilization, and the olives and olive oil are free of dangerous contamination.

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[1] GCP/RAB/013/ITA: Forest restoration in Algeria, Egypt, Morocco and Tunisia using treated wastewater to sustain smallholders' and farmers' livelihoods.

FAO/M. BALDASSO

The planted forest of Serapium grows on desert sand alongside the Suez Canal

At a workshop held in Hammamet, Tunisia, in October 2010 (FAO, 2010), wastewater treatment experts and representatives of the four countries and FAO met to develop a logical framework for a regional project. The workshop also served to establish a network of specialists in the participating countries.

The regional project became operational in March 2012 and is scheduled to be completed in 2013. Its main aim is to create, in each country, demonstration sites for the use of treated wastewater in forestry and agroforestry, with a view to raising awareness about and building capacity in the safe use and good management of treated wastewater.

In **Morocco**, the project will support the establishment of an initial 10 hectares of a future green belt in Marrakech, which will act as a buffer zone between a garbage disposal area and the wastewater plant. The green belt will be planted mostly with palm trees, although 10 percent of the area will be planted with forest species. The area will be ferti-irrigated by wastewater, and most of the organic matter will ultimately be stored in the soil. The establishment of the green belt will require the cooperation of Moroccan and Italian institutions working under the overall umbrella provided by the FAO project. To raise country capacity, the project will help train young scientists in the technology.

In **Algeria**, the project will support the planting and maintenance of a phytodepuration plant in the Brézina Oasis, El Bayadh, established by the University of Tuscia, with the aim of growing a small plantation of tamarix for bioenergy production using treated wastewater. The main aim is to demonstrate the sustainability and affordability of this technique in rural areas. The project will also support the design of a phytodepuration plant in the Taghit Oasis.

In **Egypt**, the project will work in close cooperation with the Ministry of Agriculture and Land Reclamation, the Undersecretariat of Afforestation and the Forestry Department of the University of Alexandria to prepare and implement the first management plan for the planted forest in Serapium, Ismailia, alongside the Suez Canal, which is irrigated with treated wastewater. The aim is to make this forest eligible to obtain credits for its sequestered carbon. The work will be carried out with the support of the University of Munich and the Forestry Faculty of the University of Tuscia and will help build capacity in Egypt in the management of arid-zone planted forests.

In **Tunisia**, the project will support the preparation of two demonstration areas in collaboration with the University of Basilicata and the University of Tuscia. A ferti-irrigation facility will be established near Kerouan, where a very advanced wastewater treatment facility treats water to a level suitable for agriculture. Although the system is sophisticated, however, it has high energy usage; therefore, the ferti-irrigation methodology, which would provide water for tree irrigation and organic matter for the soil, is of considerable interest. In a village in the country's south, the project will support the implementation of a low-cost, low-energy phytodepuration plant to produce water for agroforestry.

More wastewater, less waste

These demonstration projects will enable the transfer of knowledge and technology and help build capacity and raise awareness on wastewater treatment and the use of treated wastewater in agroforestry and forestry systems. Given increasing demand for water and a scarcity of supply, the use of treated wastewater is likely to expand. Forestry and agroforestry approaches can improve farmer livelihoods and turn what was once a problem into an asset. FAO Forestry is already working to support other interested countries, including Jordan, Lebanon, Libya, Pakistan, the Syrian Arab Republic, Argentina and Mexico, to engage in regional collaboration for using treated wastewater in forestry and agroforestry. ◆

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Implementing an action plan to tackle timber illegality

R. Simpson, S. Lemaitre and A. Whiteman

FAO/M. VANDENHAUTE

Combating illegality in the forest sector requires addressing its underlying causes, such as poverty, weak governance and institutions, and unrealistic legal frameworks

The European Union and FAO are working together to help countries improve forest law enforcement and governance.

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The world has a total forest area of about four billion hectares (ha), which is 31 percent of the total land area (FAO, 2010). This forest estate supports a US$224 billion global market for timber and timber products (FAO, 2012) and produces a wide variety of other economic, cultural, social and environmental benefits and services that are essential for human survival and well-being. Forests clearly have a vital role to play in a prosperous and sustainable future.

However, human-induced threats continue to undermine forest governance, law enforcement and sustainable management. Industrial agriculture, demand for cheap timber, other land uses and a changing climate all add to the burden on the forest estate. Illegal behaviour ranging from petty bribery to extreme acts of timber poaching and money laundering that enrich only a few has blemished the forest sectors of many countries. Globally, the financial loss due to illegal timber activities has been estimated at US$10–15 billion per year (The World Bank, 2002).

Concerns about illegal timber were raised at the G8 Summit in 1998, when the G8 Action Programme on Forests acknowledged that illegal logging was a serious international problem. Since then, a wide range of action plans has been created and regional activities undertaken, notably through the World Bank with the implementation of the Forest Law Enforcement and Governance (FLEG) initiative.[1] Measures to combat illegality in the forest sector must address its underlying causes, such as poverty, weak governance and institutions, and unrealistic legal frameworks. Improving forest law enforcement and governance will contribute to the development and, ultimately, sustainability of the forest sector.

The aim of VPAs is to improve forest governance by establishing a strong system to trace and verify the legality of timber

THE FLEGT ACTION PLAN

Following the example of regional FLEG initiatives, the European Commission, recognizing a joint responsibility with timber-producing countries to take action to stop illegal timber production and movement within international markets, published the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan in 2003 (European Commission, 2003). As a major consumer of timber products, the European Union (EU) plays an important role in improving the legality of timber and timber products and their associated trade.

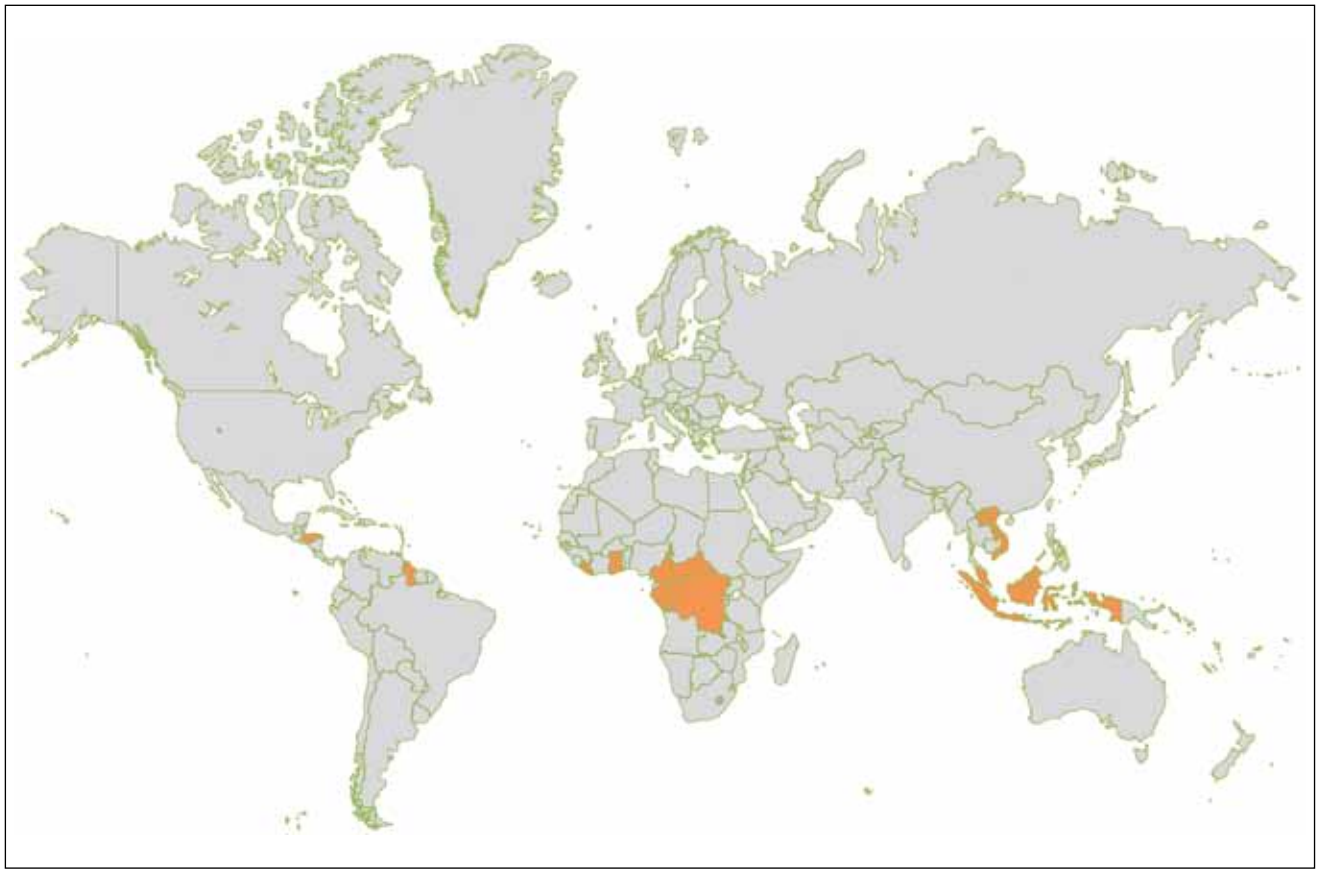
The FLEGT Action Plan focuses the EU's efforts on raising the global capacity of those responsible for improving the mechanisms that govern forest management and the extraction and trade of timber. The FLEGT Action Plan has the following thematic areas: providing support to timber-producing countries; activities to promote trade in legal timber; promoting public procurement policies; providing support to private-sector initiatives; the use of existing legislative instruments or the adoption of new legislation; and safeguards for financing and investment.

Voluntary partnership agreements

Regulation (EC) No 2173/2005 of 20 December 2005 and *Regulation (EC) No 1024/2008 of 17 October 2008* empower the European Commission to conclude voluntary partnership agreements (VPAs) with

[1] Ministerial conferences in Bali in 2001 and Yaoundé in 2003 adopted declarations whereby participating countries committed to addressing illegal activities in the forest sector.

FAO/M. VANDENHAUTE



1
Countries that are negotiating or have signed VPAs

timber-producing countries. While the decision to negotiate a VPA is voluntary, once it is signed it is legally binding.

The first VPA negotiations started with Ghana and Malaysia in 2006, with Ghana the first country to conclude a VPA. As of October 2012, the EU had signed VPAs with six countries, was negotiating with seven others (Figure 1), and had formally introduced the FLEGT/VPA process in a further 12 countries.[2]

[2] VPAs signed: Cameroon, Central African Republic, Congo, Ghana, Indonesia, Liberia; VPAs under negotiation: Democratic Republic of the Congo, Gabon, Guyana, Honduras, Lao People's Democratic Republic, Malaysia, Viet Nam; introduction to VPA or pre-negotiation phase: Bolivia (Plurinational State of), Cambodia, Colombia, Côte d'Ivoire, Ecuador, Guatemala, Myanmar, Papua New Guinea, Peru, Sierra Leone, Solomon Islands, Thailand.

European initiatives on wood procurement

The public sector in EU countries has a significant demand for wood (EFI, 2010). Several EU member states – e.g. Belgium, France, Germany, the Netherlands and the United Kingdom of Great Britain and Northern Ireland – have adopted public procurement policies for timber and timber products that require public purchasers to demonstrate that timber is of legal and/or sustainable origin, and other member states are in the process of developing such policies.

Some local authorities have also adopted procurement policies. For example, the Barcelona City Council adopted, in 2004, a timber procurement policy requiring municipal departments, districts and agencies to ensure that all wood products purchased are from sustainable forestry (Barcelona City Council, undated). Cognac, France, also requires that timber it purchases is from sustainably managed forests (City of Cognac, undated). The European Commission's policy on green procurement indicates that legality should be a minimum requirement for timber products.

In addition to government initiatives, the private sector has taken steps to improve its practices. These include the adoption of voluntary codes of conduct and international standards such as those of the Forest Stewardship Council and the Programme for the Endorsement of Forest Certification; awareness-raising; and changes in the chain of custody to minimize the risk of illegal timber entering the supply chain (Hudson and Paul, 2011).

The aim of VPAs is to improve forest governance and to ensure that only legal timber is traded on the EU market. For countries with a VPA in place, only timber stamped with a FLEGT licence will be allowed to enter the EU market. The process to conclude a VPA involves several steps: building consensus in the country among the various national stakeholders; formal negotiation; signing and ratifying the VPA; developing the system; and implementation.

Each VPA provides for the establishment of a legality assurance system (LAS). Although the contents of VPAs vary by country, certain core elements constituting the LAS are found in each: a definition of legal timber based on the national legal framework of the timber-producing country; a chain of custody; a verification system; the issuance and authorization of FLEGT licences; and independent auditing.

The EU Timber Regulation

Regulation (EU) No 995/2010 of 20 October 2010 (the EU Timber Regulation) prohibits, from 3 March 2013, the placing of illegal timber or timber products on the EU market and provides a list of the products it covers. EU member states are responsible for the implementation of the regulation, and they have designated competent authorities to ensure compliance. The EU Timber Regulation is complementary to VPAs, recognizing FLEGT licences as sufficient to demonstrate that timber is of legal origin.

The regulation requires operators to demonstrate that all timber and timber products entering the EU market are of legal origin, whether the timber is from within or outside the EU.[3] Operators must conduct "due diligence" to reduce the risk of placing illegal timber in the market. In other words, they must obtain information on the source of the timber and take reasonable steps to ensure that the timber supply is of legal origin. They are requested to keep records documenting from whom they bought the timber and to whom they sold it. If there is a high risk of illegal timber, operators must mitigate the risk by requesting additional information and verification from the supplier.

To implement the FLEGT Action Plan the EU supports a global network of FLEGT-related technical assistance. For example, the EU FLEGT Facility was established at the European Forest Institute to provide in-country technical assistance. The ACP-FLEGT Support Programme, discussed below, is also part of this global network.

THE ACP-FLEGT SUPPORT PROGRAMME

With funding from the EU, FAO established the ACP-FLEGT Support Programme to assist stakeholders in countries in Africa, the Caribbean and the Pacific (ACP) to address FLEGT-related issues as defined in the FLEGT Action Plan.

The ACP-FLEGT Support Programme funds projects implemented by local government institutions, non-governmental organizations (NGOs) and private-sector organizations, which may receive up to €100 000 to address locally defined FLEGT-related challenges. All projects must contribute to the implementation of some aspect of the FLEGT Action Plan, such as by building stakeholder capacity, developing timber verification systems, improving transparency and independent monitoring, supporting community FLEGT initiatives, and reviewing and updating relevant policies, legislation or regulations. Often, projects serve to test approaches that can be scaled up to the national level. Since its inception in 2009, the ACP-FLEGT Support Programme has supported 102 projects in 32 countries (or, in some cases, regional organizations).

The three projects described below demonstrate how the Programme is supporting both better forest management and the move to improve forest law enforcement, governance and trade.

Implementing Cameroon's VPA

Cameroon has about 19.6 million ha of forest and is Africa's largest exporter of tropical hardwood to Europe (Anon., 2010). The Government of Cameroon and the EU started negotiations for a VPA in 2007, seeing it as an "important tool to combat illegal logging and promote the long-term goal of sustainable forest management" (Anon., 2010). The VPA was signed in October 2010 and the government is currently developing its LAS.

Communities and NGOs recognize the challenge of monitoring the vast forest area necessary to establish compliance with the VPA and have sought assistance through the ACP-FLEGT Support Programme. In addition to 11 other projects, the Programme is supporting a community forest monitoring test programme managed by *Forêts et Développement Rural* (FODER), an NGO. FODER is raising awareness of forest law enforcement, governance and trade and the VPA in 20 local communities and training community members to monitor forest activities in their traditional forest areas. Equipped with global positioning systems, digital cameras and safety equipment, community forest guards are able to determine appropriate cutting areas and harvesting techniques, and they have gained an understanding of the legal framework under which logging is governed. In the short period in which the project has been operational, community patrols have completed a number of field observations and reported two cases of illegal logging. Although a small initiative, this project demonstrates that, when empowered, communities have the capacity and will to monitor and manage their forest estates and to observe the rule of law. In remote forest areas this can mean significant cost savings for national governments, which are already straining to fulfil other law enforcement commitments.

Community-based FLEGT initiative in PNG

In Papua New Guinea, the implementation of forest-related laws and regulations

[3] Operators are defined by the EU Timber Regulation as "any natural or legal person that places timber or timber products on the market".

FODER/R. NGONZO

Community members receive training on participatory forest monitoring from FODER, a Cameroonian NGO

tends to favour large-scale investments and restrict the meaningful participation of local people in forest management (Blaser *et al*., 2011); in some cases this has led to conflict between local people, the government and investors (Warner, 2000). The ACP-FLEGT Support Programme is supporting the Foundation for People and Community Development in Papua New Guinea to educate, empower and organize local people to manage their forest resources. It is doing so by providing communities with training in sustainable forest management and helping them to legally establish their land management claims in traditional territories.

The Chiquibul forest, Belize

Belize has about 1.4 million ha of forest, which is 61 percent of the country's land area. The Chiquibul National Forest comprises almost undisturbed forest and features rare and endangered species such as the tapir, jaguar and scarlet macaw and an important archaeological reserve. It is

FCD/R. MANZANERO

A forest guard notes the location of an illegal cache of timber as part of a monitoring system to curb degradation in the Chiquibul National Forest, Belize

under threat, however, from illegal logging. Recently, Friends for Conservation and Development (FCD), a locally based NGO, has suggested that an illegal logging network worth up to US$15 million exists in the Chiquibul National Forest (FCD, 2011). Illegal loggers enter with chainsaws and horses to fell and process timber and carry it to the market.

FCD, supported by the ACP-FLEGT Support Programme, has mounted a coordinated effort – including stronger law enforcement and environmental education for local communities – to curb forest degradation in the area. It has trained two forest protection teams comprising the military, police and park officials and is supporting them to patrol the forest. In the short time in which the patrols have been operating they have encountered gunfire, arrested numerous illegal loggers, and confiscated chainsaws and horses.

Some perpetrators are crossing the border from Guatemala, raising the profile of the problem to the international level. FCD and members of the Government of Belize have opened a dialogue with Guatemalan authorities to address the timber-smuggling network.

THE NEXT PHASE

Significant progress towards the implementation of the FLEGT Action Plan has been achieved in recent years through various interventions. With the approaching entry into force of the EU Timber Regulation, FAO is reviewing the approaches, success factors and challenges in the implementation, in the last three years, of the FLEGT Action Plan. To this end, the ACP-FLEGT Programme, in partnership with the Forestry Commission of Ghana, the EU FLEGT Facility and theIDLgroup, convened, in October 2012 in Accra, a regional conference on experiences from the VPA process in West and Central African countries. This conference, which was attended by about 130 participants from VPA-involved countries in Africa and other regions, enabled participants to share and discuss experiences, opportunities, successes and challenges and to identify the path forward for the VPA process. A compendium highlighting 16 experiences and the lessons learned was also released. A collaborative study by FAO and the EU FLEGT Facility is under

EU-FAO FLEGT Programme

The EU-FAO FLEGT Programme is a 4-year initiative that started in May 2012, funded by the EU and implemented by FAO. It is a follow-on programme to the ACP-FLEGT Support Programme and has two components:

- **project support to local stakeholder groups in developing countries to put the FLEGT Action Plan into practice; and**
- **information services.**

The EU FAO FLEGT Programme provides assistance to three stakeholder groupings in eligible countries: government institutions, civil-society organizations and private-sector organizations. Assistance is based on:

- **calls for proposals for the three stakeholder groupings; and**
- **direct assistance requested by government institutions.**

The Programme has separate approaches by which VPA and non-VPA countries may apply for assistance. It aims to increase the availability of FLEGT-related information and knowledge and experiences among local stakeholder groups by supporting actions to improve understanding of the FLEGT Action Plan and forest law enforcement, governance and trade more generally.

way to draw lessons from the experiences so far and to improve the clarity of VPAs, address loopholes and provide guidance for other VPA processes.

The ACP-FLEGT Support Programme recently moved into a second phase (called the EU-FAO FLEGT Programme, see box) that has two foci: the needs of countries entering into VPAs; and those developing countries that are still formulating forest law enforcement, governance and trade strategies. Consistent law enforcement, improved governance and assurances of legality, as developed through the FLEGT Action Plan, are part of the foundation that must be laid if forests are to be truly sustainable. ◆

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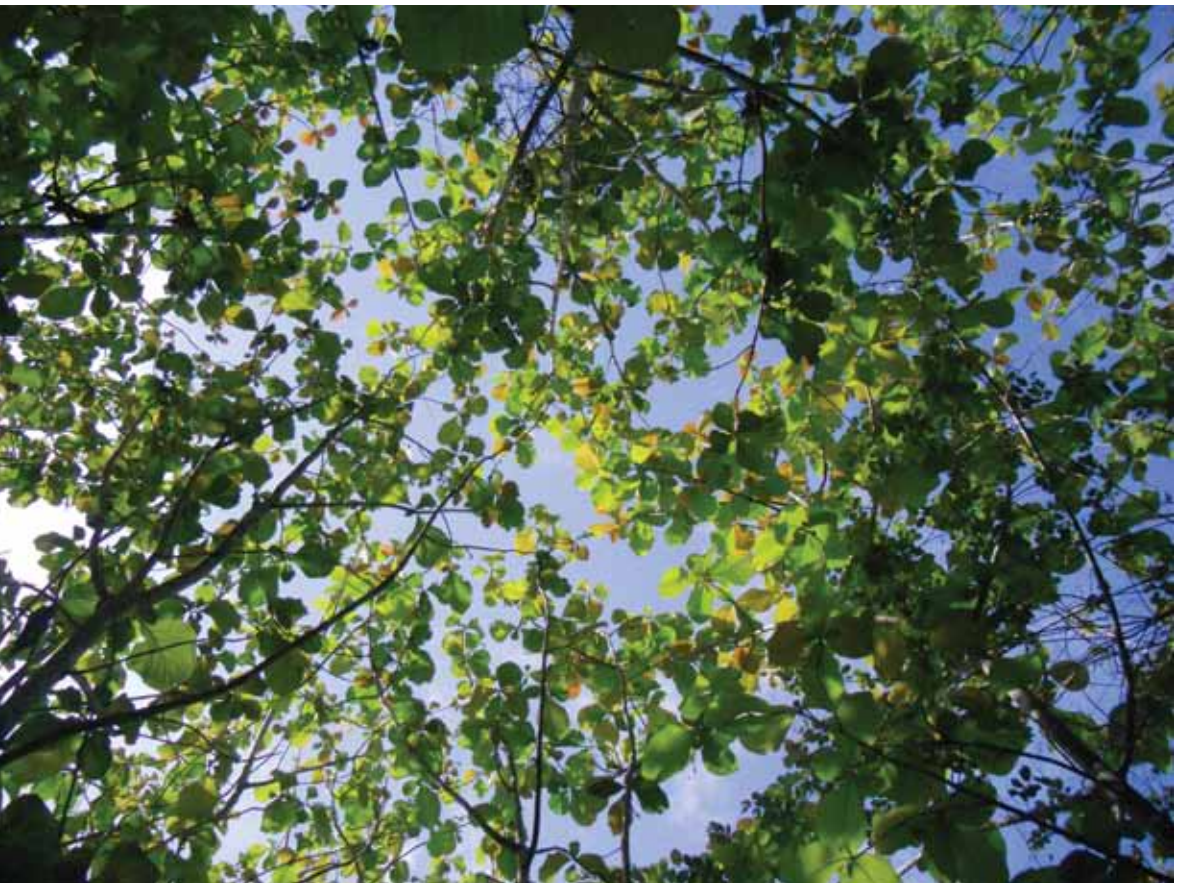
FORESTS THROUGH YOUR LENS

In the final quarter of the International Year of Forests 2011, FAO Forestry solicited photographs of the **forests that people know and love**, through its Infosylva news clippings service (www.fao.org/forestry/infosylva), among other outlets. The competition sought images that showed their photographers' connections to the forests that they serve.

The winning photographs are presented in this section. These photographs and other standouts are available in the FAO Forestry photo library (www.fao.org/mediabase/forestry).



▲ **Lina Farida Jihadah**
Wanagama Educational Forest, Gunung Kidul District, Yogyakarta, Indonesia
"For me as young forester, (this photo shows) that trees and forests can inspire me to carve my forestry **dreams as high as the skies**, even higher."

▶ Vidhi Billore
Ralamandal Sanctuary, Indore District, Madhya Pradesh, India
"My son Joshua and his friend Rudraksh take a walk in the forest, reminding me of how my childhood is replete with memories of moments spent in the **lap of nature**, and leaving me wondering if my son will have the same privilege."

▼ Noah James Chutz
Wrangell-St. Elias National Park, Alaska, United States of America
"These forests exist in the Northern extremes, smashed between glaciers and jagged mountains, providing **habitat to both people and wildlife** and adapted to life at high altitudes ... I dedicate my life to forests so pictures like this can still exist."

▲ Johnson Herve Rakotoniaina
Market, Mahazo, Madagascar
"This photo shows **medicinal plants** – bark, trunk and root – from the north and south of Madagascar, for sale in urban areas. They are not just for the people around forests, but for all of us."

INTERNATIONAL YEAR OF FORESTS • 2011

▲ **Supratim Bhattacharjee**
Birbhum District, West Bengal, India
"When you are living in a jungle of concrete, a forest is a place where a human can take a **fresh breath** without any kind of obstruction."

▲ **Celso Coco**
Las Médulas (ancient Roman gold mines), Léon, Spain
"When the mining had ended, vegetation was planted in the area, forming what is now a forest of chestnut *(Castanea sativa)*. The site is now a "natural monument", a protected area under the Castile and Leon regions. For me (the photo) shows how **human development** has been linked to nature, through time."

◀ **Francisco Miguel Agostinho Caetano**
Mafra, Portugal
"The forest means to me more or less the same as what **life itself** means to a medical doctor. The more you understand and deal with its complexity, the more you get amazed and thankful for the simple fact of its existence."

▲ **Janelle Bianca C. Fernandez**
Pagbilao Mangrove Experimental Forest, Quezon Province, Philippines
"The forest is a precious, living entity. It provides everything and is **the source of all**."

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The opening session of the Twenty-first Session of COFO at FAO headquarters

Twenty-first Session of the Committee on Forestry and third World Forest Week

The Twenty-first Session of the Committee on Forestry (COFO) was held at FAO headquarters, Rome, Italy, on 24–28 September 2012 in conjunction with the third World Forest Week. The session was attended by 618 people, comprising delegates from 129 countries and one member organization, representatives of seven United Nations agencies and programmes and the Holy See, and observers from 25 intergovernmental organizations and international non-governmental organizations.

The COFO agenda was developed with the direct support of the COFO Steering Committee based on inputs from the regional forestry commissions, and recommendations for FAO Forestry were developed in the same manner. The overall theme of the event was "Forests: a green pathway for human development". Delegates discussed how best to translate the outcomes of Rio+20 into action and recommended that FAO consider supporting countries in enhancing the contribution of forests and forest products to economic development and seek ways to maximize the contribution of forests to greening economies.

There was also considerable discussion on ways of strengthening forestry's cross-sectoral linkages, under the following themes:

- integrating forests with environmental and land-use policies at all levels;
- forests, trees and people together in a living landscape: a key to rural development;
- broadening the financial basis for sustainable forest management: wood and non-wood products, services, innovations, markets, investments and international instruments;
- sound information and knowledge base for better policies and good governance.

COFO made a number of recommendations, including that FAO support countries in:

- promoting the important role of forests in maintaining the productivity of agriculture and natural resources and in strengthening forestry and agricultural linkages across sectors, policies and agencies to improve food security;
- achieving their development goals for wood energy;
- strengthening governance mechanisms and integrating forest issues into key environmental and land-use policies at all levels and by hosting and supporting the Forest and Farm Facility;
- strengthening national forest information systems and promoting interorganizational collaboration at all levels to strengthen the information and knowledge base for forest-related governance.

COFO also recommended that the FAO Council consider:

- identifying FAO's role in achieving the Bonn Challenge and strengthen its capacity in land-use planning;
- increasing support for the development of improved tools and mechanisms for enhanced financing of the forestry and rangelands programmes in member countries in the Near East Region;
- implementing the Global Forest Resources Assessment Long-term Strategy and prepare a set of voluntary guidelines on national forest monitoring;
- strengthening the FAO fire management programme;
- taking into account the recommendations of the strategic evaluation;
- providing information to members on the intended steps for strategic planning and clarify how work on forests will be budgeted;
- implementing the recommendations of the regional forestry commissions.

In parallel to COFO, nearly 50 side-events were held to communicate, more intimately, forest-related initiatives, challenges and changes at the global, regional and country levels. For the first time, a forestry share fair was also held. Share fairs are interactive events at which information and knowledge about projects, programmes, initiatives and ideas are shared in participatory and engaging ways. Its purpose is to enable interactive multi-way exchanges among participants, creating an environment of trust in which everyone learns together. Participants talk about how to do things better and how to best go forward in their own work. During COFO and the third World Forest Week, seven share-fair events were held on topics ranging from a proposed "SFM toolbox" to forest policy in Central Africa.

FAO's contribution to the International Year of Forests

The United Nations General Assembly declared 2011 the International Year of Forests (IYF) and requested the Secretariat of the United Nations Forum on Forests to serve as the international focal point for its implementation, in collaboration with governments, the Collaborative Partnership on Forests (CPF) and international, regional and subregional organizations and processes as well as relevant major groups. The purpose of the IYF was to raise awareness on the sustainable management, conservation and sustainable development of all types of forests for the benefit of current and future generations. "Forests for people" was the IYF's main theme, highlighting the dynamic relationship between forests and the people who depend on them.

To support national efforts to promote the IYF, FAO developed a communication toolkit as an open source for both national authorities and civil society. This saved money and human resources in the field, as officers were not required to invest resources in producing their own materials. This toolkit, which continues to be developed, can be found at www.fao.org/forestry/iyf2011/toolkit/en/. An application for use on mobile devices was created to increase the accessibility of FAO forestry-related information and to act as a tool for learning and education. FAO regional offices increased the visibility of the IYF, including through various publicity activities and events.

Collaborative actions from CPF member organizations involved an IYF timetable, with selected members responsible for developing specific programmes, including thematic press releases, related to monthly themes. Of 26 identified themes, FAO was the lead agency for:

- forest and water;
- managing risks of forests under climate change;
- forests and tourism;
- urban forestry;
- forests and food security;
- forests and mountains.

The IYF helped spread the message of the importance of forests to a wide audience, and it highlighted the potential advantages of establishing a mechanism to sustain attention on forests. At its 20th Session (Rome, 4–8 October 2010), COFO recommended that countries and FAO consider capitalizing on the momentum generated during the IYF by observing an International Day of Forests. The United Nations General Assembly will consider the idea when it convenes in late 2012.

Countries adopt global guidelines on tenure of land, forests and fisheries

In May 2012 the FAO Committee on World Food Security (CFS) endorsed a set of global guidelines aimed at helping governments safeguard the rights of people to own or access land, forests and fisheries.

The *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* outline principles and practices that governments can refer to when making laws and administering land, fisheries and forest rights. They are based on an inclusive consultation process started by FAO in 2009 and then finalized through CFS-led intergovernmental negotiations that included the participation of government officials, civil-society organizations, private-sector representatives, international organizations and academics. The aim of the guidelines is to promote food security and sustainable development by improving secure access to land, fisheries and forests and protecting the rights of millions of often very poor people.

"Giving poor and vulnerable people secure and equitable rights to access land and other natural resources is a key condition in the fight against hunger and poverty. It is a historic breakthrough that countries have agreed on these first-ever global land tenure guidelines. We now have a shared vision. It's a starting point that

will help improve the often dire situation of the hungry and poor," said FAO Director-General José Graziano da Silva.

Much public debate has focused on the "land-grabbing" phenomenon, which is one of the issues dealt with in the guidelines. While the guidelines acknowledge that responsible investments by the public and private sectors are essential for improving food security, they also recommend that safeguards be put in place to protect the tenure rights of local people from risks that could arise from large-scale land acquisitions and also to protect human rights, livelihoods, food security and the environment.

Investment models exist that do not result in the large-scale acquisition of land, and these alternative models should be promoted. Investments should also promote policy objectives such as boosting local food security and promoting food security, poverty eradication and job creation, and "provide benefits to the country and its people, including the poor and most vulnerable".

The guidelines address a wide range of other issues as well, including:

- the recognition and protection of legitimate tenure rights, even under informal systems;
- best practices for the registration and transfer of tenure rights;
- making sure that tenure administrative systems are accessible and affordable;
- managing expropriations and restitution of land to people who were forcibly evicted in the past;
- the rights of indigenous communities;
- ensuring that investment in agricultural lands occurs responsibly and transparently;
- mechanisms for resolving disputes over tenure rights;
- dealing with the expansion of cities into rural areas.

Graziano da Silva said that FAO stands ready to provide support and assistance to countries in adapting and implementing the guidelines. The Organization will now develop a series of technical handbooks designed to help countries adapt the guidelines to their local contexts and put them into play. The Organization will also provide targeted technical assistance to governments towards that same end.

In October 2012 the FAO Committee on Forestry invited member countries to implement the guidelines and recommended that FAO support their implementation.

Adapted from a press release issued by FAO on 12 May 2012.

FAO Director-General José Graziano da Silva

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FAO/R.M. ROCHA TEIXEIRA

Rio+20

The United Nations Conference on Sustainable Development was convened in Rio de Janeiro, Brazil, on 20–22 June 2012 to discuss sustainability and agree to common actions in seven major areas. The conference, known as Rio+20, reviewed the progress that has been made towards sustainable development in the 20 years since the 1992 Earth Summit, which was also held in Rio de Janeiro. The two main themes of Rio+20 were green economy, and the institutional framework for sustainable development. The seven main areas discussed were jobs, energy, sustainable cities, food security and sustainable agriculture, water, oceans and disaster readiness. Although forests were not a key focus of Rio+20, delegates had an opportunity to reinforce the message that forests and forest products can help address challenges in each of these seven main areas.

In its submission to Rio+20, the Collaborative Partnership on Forests (CPF), of which FAO is a member and the Chair, stressed the importance of taking a "landscape approach" to the management of natural resources. Such an approach works across sectors and institutions to ensure that the environmental, economic and social aspects of forests are taken into account in decision-making. The CPF members noted how forests can help countries to alleviate poverty, meet the Millennium Development Goals, develop rural areas, reduce the risks posed by climate change, ensure food security, boost agricultural productivity, improve energy availability and maximize trade. They suggested that countries can benefit if they move to greener economies, and forests can provide bioenergy, ecosystem services, materials for sustainable and energy-efficient buildings and improved livelihoods for people living in remote rural areas. Maximizing the benefits of forests, suggested the CPF members, requires strengthened forest-related institutions; greater capacity for forest management; improved education and institutions; payments for ecosystem services; the decentralization of forest management rights; the adoption of coherent and coordinated policies; and the improvement of value chains.

The outcome document of Rio+20, called *The Future We Want*, was a product of "the heads of State and Government and high level representatives, ... with full participation of civil society". It contains four paragraphs specifically on forests, stressing that the forest sector has a role to play in a variety of areas, including through the provision of sustainable products and services; reforestation, restoration and afforestation to reverse deforestation; sustainable forest management; the reduction of risks from climate change; and the strengthening of cooperation, capacity building and governance. The paragraphs dedicated to forests also note the importance of the CPF and its role in working with international processes such as the United Nations Forum on Forests to promote international forest policy and with countries to promote sustainable forest management. The document reaffirmed "the necessity to promote, enhance and support more sustainable agriculture, including crops, livestock, forestry, fisheries and aquaculture, that improves food security, eradicates hunger, and is economically viable, while conserving land, water, plant and animal genetic resources, biodiversity and ecosystems, and enhancing resilience to climate change and natural disasters" and recognized "the need to maintain natural ecological processes that support food production systems".

The 68th United Nations General Assembly, to be convened in late 2012, will discuss follow-up actions to Rio+20. FAO and the CPF are involved in these discussions and, in particular, are interested in seeing how forests might be including in future Sustainable Development Goals (SDGs) that could address topics such as halting forest loss and reversing forest degradation and other issue areas included in *The Future We Want*.

Above: Eduardo Rojas-Briales, Assistant Director-General, FAO Forestry Department, speaks during an event at Rio+20 to highlight the role of forests in fostering local livelihoods.

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Narayan Kaji Shrestha accepts the Wangari Maathai Award at FAO headquarters

Inaugural Wangari Maathai Award winner

Narayan Kaji Shrestha, of Nepal, has won the first-ever CPF Wangari Maathai Award for his outstanding contribution to forests. The award was established this year to honour the life and work of the late Kenyan environmentalist Wangari Maathai, a champion of forest issues worldwide and the first African woman to win the Nobel Peace Prize.

Dr Shrestha is recognized as one of main architects of the community forestry movement in Nepal, which he has been encouraging for three decades and which has contributed significantly to restoring forests in the country. He guided early attempts to create a more participatory approach to community decision-making, reaching out to women and low-caste villagers and initiating the country's first user-managed community forestry group.

More than one-quarter of Nepal's forests are now protected and managed by community forest user groups. In addition to influencing legislation, Dr Shrestha provided leadership to the national organization that later became the Federation of Community Forest Users in Nepal, and he continues to guide and mentor many practitioners and leaders involved in participatory resource management.

"Dr Shrestha's work captures the spirit of Wangari Maathai,"said FAO Assistant Director-General, Forestry, Eduardo Rojas Briales, a member of the jury that selected the award-winner. "His vision, courage, commitment, intelligence and praxis is recognized through this award."

Dr Shrestha received the US$20 000 award at a ceremony at FAO headquarters in Rome during the Twenty-first Session of the Committee on Forestry and the third World Forest Week.

The jury also awarded Kurshida Begum, of Bangladesh, an Honourable Mention prize, including US$2 000, for her work helping women in her village to form a community patrol group alongside forest department guards to protect the forests and biodiversity of the Tenkaf Wildlife Sanctuary from illegal logging and poaching. Her work has helped women gain an effective voice in their community and provided them with a steady source of income. It has also helped to communicate the importance of forest and natural resource issues to sanctuary visitors.

BOOKS

State of the art in forest fire management

Community-based fire management: a review. 2011. FAO Forestry Paper No. 166. Rome, FAO. ISBN 978-92-5-107094-9.

The concept of community-based fire management (CBFiM) emphasizes the importance of local communities in policy development and fire management practices.

This publication is based on the experiences of FAO and partners in CBFiM. It highlights the state of the art in CBFiM and provides updated information that complements the approach published previously in the Fire Management Voluntary Guidelines.

Case studies from three continents highlight the importance of community access to land and natural resources, particularly in relation to fire management decision-making. The publication emphasizes the need to include CBFiM in the planning and implementation of projects for reducing emissions from deforestation and forest degradation.

The publication defines current limiting factors of implementation while underlining the importance of effective partnerships within and outside communities. It concludes with a call to continue the development of tools and resources to assist CBFiM practitioners with their implementation of CBFiM.

Also available online: www.fao.org/docrep/015/i2495e/i2495e00.htm.

For more information on FAO's fire management programme, visit: www.fao.org/forestry/firemanagement/en/.

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Climate change, wild animals – and their habitats

Wildlife in a changing climate. 2010. FAO Forestry Paper No. 167. Rome, FAO. ISBN 978-92-5-107089-5.

For the past 20 years, climate change has been high on the international agenda. Together with desertification, soil degradation and biodiversity loss, it is widely recognized as the major environmental threat the world is facing. Evidence is increasing that warming and other climate-related changes are happening more quickly than anticipated, and prognoses are becoming worse.

This publication analyses and presents how climate change affects or will likely affect wild animals and their habitats. Although climate change has already been observed and monitored over several decades, there are not many long-term studies on how the phenomenon is affecting wildlife. There is growing evidence, however, that climate change exacerbates other major human-induced pressures such as encroachment, deforestation, forest degradation, land-use change, pollution and overexploitation of wildlife resources.

Case studies describe some of the body of evidence and provide projections of likely scenarios. An emphasis of this book is on tropical terrestrial ecosystems. Subtropical, temperate and boreal regions, as well as coastal areas and inland waters, are covered to a lesser degree.

The publication not only highlights climate-induced changes and their likely consequences, it also provides useful and up-to-date information on how these consequences could be addressed by skilful measures of adaptive management. The findings and suggested measures explore current knowledge and propose a way forward.

Also available online: www.fao.org/forestry/30143-0bb7fb87ece780936a2f55130c87caf46.pdf.

To watch a video on mountain gorillas in Rwanda, based on the publication, visit: www.youtube.com/watch?v=PAR7Mwv3848.

For more information on FAO's wildlife and protected area management programme, visit: www.fao.org/forestry/wildlife/en/.

Advancing the use of assisted natural regeneration

Forests beneath the grass: proceedings of the regional workshop on advancing the application of assisted natural regeneration for effective low-cost forest restoration. 2011. Regional Office for Asia and the Pacific Publication 2010/11. Bangkok, FAO. ISBN 978-92-5-106639-3.

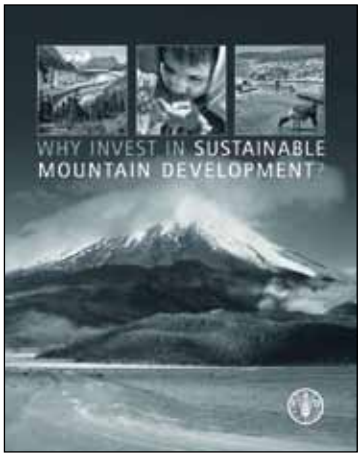
Although forests have been increasingly recognized for the wide range of environmental and social values essential for our planet's well-being, unsustainable forest and land-use practices continue to destroy and degrade millions of hectares of forest in Asia and the Pacific each year. Vast areas of deforested and degraded lands have been taken over by highly invasive grasses such as *Imperata cylindrica*. These largely unproductive grasslands harbour little biodiversity and provide very few livelihood options for local people.

Assisted natural regeneration (ANR) is a forest restoration and rehabilitation practice successfully used for converting *Imperata cylindrica* and other grass-dominated areas into productive forests. It is a simple, inexpensive and effective technique that relies on the natural processes of plant succession, including the regeneration and growth of indigenous species. ANR application is based on fire prevention and management, control of grazing, suppression of grasses and nurturing of seedlings and saplings of indigenous trees. Experiences with ANR demonstrate that this approach is particularly successful in engaging local communities, reducing the risk of forest fire and creating new income-generating opportunities.

This publication presents the proceedings of a regional workshop, convened in the Philippines in 2009, on advancing the application of ANR for effective, low-cost forest restoration.

Also available online: www.fao.org/docrep/014/i1734e/i1734e00.htm.

Watch a video about regenerating forests in the Philippines: www.youtube.com/watch?v=JVUNajoHmi8.



Mountains on the international agenda

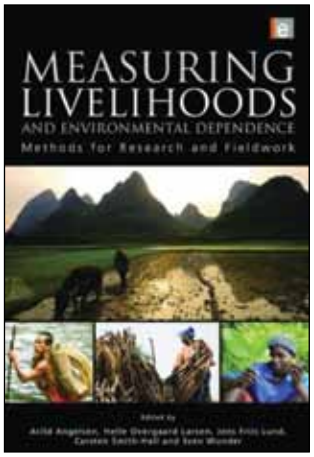
Why invest in sustainable mountain development? 2011. Rome, FAO. ISBN 978-92-5-107012-3.

Mountains cover approximately one-quarter of the world's surface and are home to 12 percent of the human population. By providing freshwater and other key ecosystem services to more than half of humanity, mountain ecosystems play a crucial role in the development of the planet and contribute significantly to the well-being of human societies. This booklet summarizes state-of-the-art information on the characteristics of and threats to mountain ecosystems, the ecosystem services they provide and the impacts of climate change; explains approaches to sustainable mountain development, including natural resource management, economic opportunities and mountain policies and governance; and describes the way forward and provides recommendations for addressing sustainable mountain development at the global and local levels.

The booklet is addressed primarily to those policy- and decision-makers who are responsible for finding a balance between socio-economic development and environmental conservation thrusts. It shows that sustainable mountain development plays a fundamental role in addressing current global challenges and therefore requires and deserves a prominent place on the international agenda.

Also available online: www.fao.org/docrep/015/i2370e/i2370e.pdf.

For more information on FAO's Watershed management and mountains programme, visit: www.fao.org/forestry/watershedmanagementandmountains.



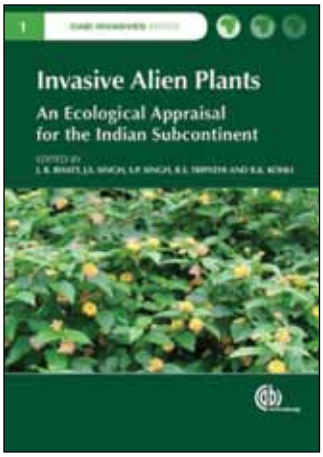
Methods for quantifying rural livelihoods

Measuring livelihoods and environmental dependence: methods for research and fieldwork. A. Angelsen, H.O. Larsen, J.F. Lund, C. Smith-Hall & S. Wunder, eds. 2011. London, Taylor & Francis, Inc. ISBN 978-1-84971-132-6.

Measuring rural livelihoods and understanding natural resource dependence are keys for improving living conditions and decreasing poverty in rural areas. Conducting research in the field is often challenging; many studies suffer from weaknesses in methods and problems in implementing research. This book gives guidance on the design and implementation of household and village surveys in developing countries that aim to collect data and assess rural livelihoods quantitatively.

The book is based on the experiences of the Poverty Environment Network, an international research project and network on the linkages of poverty, environment and forest resources. It describes the entire research process step by step, starting from the development of the research proposal to the selection of sampling techniques and design of questionnaires. It covers issues such as the valuation of non-marketed products and the organization of the fieldwork. The book concludes with chapters on data entry and analysis, as well as on how to communicate research results to support and strengthen evidence-based policy making. The various research and fieldwork methods presented in the book are complemented with practical field experiences.

This practical handbook presents a solid methodological framework for students, researchers and professionals designing and conducting surveys to quantify rural livelihoods.



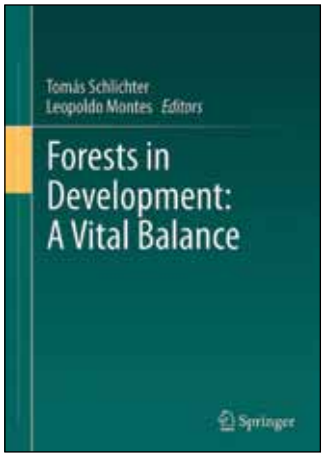
Invaders of the Indian subcontinent New CABI series

Invasive alien plants: an ecological appraisal for the Indian subcontinent. CABI Invasives Series No. 1. J.R. Bhatt, J.S. Singh, S.P. Singh, R.S. Tripathi & R.K. Kohli, eds. 2011. Wallingford, UK & Cambridge, USA, CAB International. ISBN 978-1-84593-907-6.

Invasive alien species are a major threat to biodiversity and ecosystems throughout the world. In India, a country with 4 of the 34 world's important "biodiversity hotspots", the invasion of alien plants means risking a national ecological disaster with major social and economic consequences.

Currently, there is insufficient information about invasive alien plants. Their distribution, rate of spread and adaptability to new environments are relatively unknown. This book reveals existing and potential invaders of the Indian subcontinent and evaluates their environmental impact and the level of risk they pose to native species. It suggests steps to manage the spread of these invaders and limit the damage they cause. With a comprehensive section on management and legislation, this book should be of interest to policy-makers, as well as to researchers of invasive plants, worldwide.

The CABI Invasive Species Series addresses all topics relating to invasive species. Aimed at researchers, upper-level students and policy-makers, titles in the series provide international coverage of topics related to invasive species, including both a synthesis of facts and discussions of future research perspectives and possible solutions.



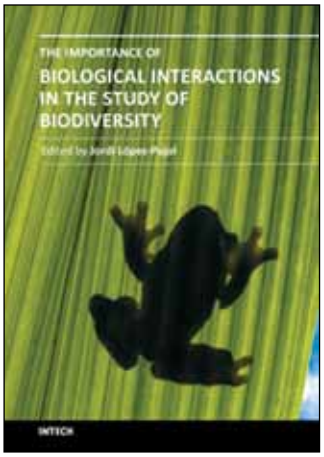
Beyond the XIII World Forestry Congress

Forests in development: a vital balance. T. Schlichter & L. Montes, eds. 2012. Dordrecht, the Netherlands, Heidelberg, Germany, London & New York, USA, Springer. ISBN 978-94-007-2575-1; e-ISBN 978-94-007-2576-8. DOI 10.1007/978-94-007-2576-8.

Forests in development: a vital balance shows some of the main advances in forestry over the six years between the XII World Forestry Congress in Quebec, Canada, and the XIII World Forestry Congress held in Buenos Aires.

The book covers most of the themes of the XIII World Forestry Congress, from biodiversity through production, policies, environmental services and economic aspects, linked by sustainability. It provides a comprehensive view of forestry today, conveying its different aspects through one solid piece addressed by authors whose work denotes a concept of sustainable forest management that is not so much a puzzle laboriously put together as a many-faced unity, steered to achieve, ultimately, a better quality of living for present and future generations.

A persistent theme throughout the chapters reflects the dynamics of changes acting upon forests and forestry and the adaptation of policies, management and objectives, if they are to continue providing support to societies. Among topics addressed are: what the aims of forest management will be, in the face of these changes; drivers that regulate forest growth and its relation to the ecosystem and ecosystem services, and the influence of these factors on forest management; the future of finance in forestry; ecosystem health, taking into account a changing climate; information for forest plantation management; bioenergy production; and other technical, economic and political aspects.



Biodiversity and biological interactions

The importance of biological interactions in the study of biodiversity. J. López-Pujol, ed. 2011. Rijeka, Croatia, InTech. ISBN 978-953-307-751-2. Open Access, available at: www.intechopen.com/books/the-importance-of-biological-interactions-in-the-study-of-biodiversity.

The term "biodiversity" was coined in the mid 1980s but became popularized in 1992 at the United Nations Conference on Environment and Development (held in Rio de Janeiro, Brazil). According to the Convention on Biological Diversity, which came into force soon after the Rio summit, biodiversity is defined as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". This definition clearly states that the term comprises all the variety of life, in all its manifestations, at all its levels of organization, and including their complex interactions. The biological interactions are, thus, a central aspect of the biological diversity. There is not much sense in studying a single species without taking into account the rest of the species occurring in that habitat and how they interact. However, interactions should be studied in their broadest sense, i.e. considering not only the relationships between living organisms, but also those between living organisms and the abiotic elements of the environment (e.g. soil, water and climate).

This volume contains 19 contributions illustrating the state of the art of academic research in the field of biological interactions in their widest sense; that is, not only the interactions between living organisms, but also those between living organisms and abiotic elements of the environment, as well as those between living organisms and human living organisms.

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